DOCUMENT RESUME

ED 276 087 EA 018 207

AUTHOR Jenkins, Judith, Ed.
TITLE Guide for Planning Educational Facilities. An Authoritative and Comprehensive Guide to the Planning of Educational Facilities from the Conception of Need through the Utilization of the Facility. Eighth Edition.
INSTITUTION Council of Educational Facility Planners, International, Columbus, OH.
PUB DATE 85
NOTE 232p.; Photographs may not reproduce well.
AVAILABLE FROM Publication Sales, Council of Educational Facility Planners, 29 West Woodruff Avenue, No. 325, Columbus, OH 43210 ($25.00; quantity discounts).
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Architectural Character; Budgeting; *Building Design; Campus Planning; College Buildings; Design Requirements; Educational Environment; *Educational Equipment; *Educational Facilities Design; Educational Facilities Improvement; *Educational Facilities Planning; Elementary Secondary Education; Facility Guidelines; Higher Education; Land Use; Site Development; Site Selection; Space Utilization

ABSTRACT

This document, in a looseleaf format that allows for the easy addition of annual updates, is a compilation of information to be used in the planning of educational buildings from the conception of needs through occupancy and use. Each unit contains numerous photographs, drawings, and figures that illustrate the contents. Unit subjects are as follows: historical perspectives; planning resources; developing a master plan; the planning professionals; program requirements; the site; spaces for learning; auxiliary spaces; the learning environment; equipping the facility; project budget and cost control; financing the capital program; the construction program; renovation, alteration, and conversion; orientation and evaluation; college and university planning; and buying, selling, and leasing. A five-page index is appended. (IW)

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ED276087

guide for planning educational facilities

An authoritative and comprehensive guide to the planning of educational facilities from the conception of need through the utilization of the facility.

EA 018 207

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PREFACE

The Council of Educational Facility Facility Planners began compiling information about school planning in the 1930s. The most widely used of its publications is the GUIDE FOR PLANNING EDUCATIONAL FACILITIES, issued in 1953, 1958, and 1964 as the GUIDE FOR PLANNING SCHOOL PLANTS. Rapid changes in educational programs, teaching methods, and planning processes were recognized in the 1969 and 1976 editions of the GUIDE. These rapid changes prompted the Council to publish the GUIDE in a looseleaf format to encourage continuous revision of each unit and to make it possible to add new units without total revision of the book. The Council also appointed an Update Committee which is responsible for the revision process. One third of the units are revised annually in order that the Guide may be totally revised every three years. The Guide Update Committee solicits ideas, suggestions, and comments from readers and users. A mailer response page is included for this process.

The Council also publishes the CEFP JOURNAL, which contains valuable, current articles relevant to educational facility planning. The CEFP JOURNAL is available without charge to Council members, or it may be obtained by separate subscription from CEFP Headquarters:

Council of Educational Facility
Planners, International
29 West Woodruff Ave.
Columbus, Ohio 43210

Dwayne E. Gardner
Executive Director

GUIDE FOR PLANNING EDUCATIONAL FACILITIES

EDITOR JUDITH JENKINS
Communications Supervisor
Council of Educational Facility Planners
Columbus, Ohio

GRAPHICS J. JEFFREY CONROY
Architect
Caudill Rowlett Scott
Houston, Texas

C. WILLIAM BRUBAKER
Chairman and President
Perkins & Will Architects, Inc.
Chicago, Illinois

DESIGN and PRODUCTION CHARLES STANLEY
Educational Planner
Council of Educational Facility Planners
Columbus, Ohio

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Originally published 1953 as *Guide for Planning School Plants* and revised 1958 and 1964. Published 1969 as *Guide for Planning Educational Facilities* and revised in 1976, 1983, and 1985. Library of Congress Catalog Number: 76-17296. Printed in the United States of America.

COUNCIL OF EDUCATIONAL FACILITY PLANNERS, INTERNATIONAL

Purpose

The Council of Educational Facility Planners, International, is a nonprofit organization of individuals and corporate groups whose professional activities involve a responsibility for planning, designing, creating, equipping, and maintaining the physical environment for education. The Council seeks to further the goals of education by providing services, activities, and knowledge related to teaching and learning environments.

History

The National Council on Schoolhouse Construction was founded in 1921 to "promote the establishment of reasonable standards for school buildings and equipment with due regard for economy of expenditure, dignity of design, utility of space, healthful conditions and safety of human life."

The Council's influence has extended to include facilities for preschool, higher education, and lifelong learning, as well as elementary and secondary education. In 1965, CEFP membership opened to consulting firms in architecture, engineering, and educational planning. In 1967, the Council changed its name to the Council of Educational Facility Planners, reflecting the extended scope of membership and breadth of professional interest.

CEFP expanded again in 1969 when membership categories were established for industrial firms, institutions and students whose interests and activities relate to educational facility planning. At the close of its first half-century in 1971, the word *International* was added to the Council's name to acknowledge its influence worldwide and to recognize its many members from beyond the North American continent.

Participation

Council members meet annually, sharing their ideas and experiences, strengthening their professional expertise, and expanding their knowledge of educational facility planning and the planning process. The Council is decentralized into geographic regions making it possible for its members to participate in conferences and workshops where regional or local concerns may vary from international perspectives. Members are encouraged to participate at the international, regional, and local levels.

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Winter Park, Florida

LESTER W. HUNT
Director
Educational Planning
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Atlanta, Georgia

OHIO STATE UNIVERSITY
Facilities Planning Services
North Oval
Columbus, Ohio

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Continuing Education Service
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Passantino/JRB Architects
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Kentwood Public Schools
Grand Rapids, Michigan

DOUGLAS R. SHERMAN
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University of Michigan
Ann Arbor, Michigan

S. SIREN
Architect
Hinton, Alberta, Canada

YALE STENZLER
Executive Director
Public School Construction Program
Baltimore, Maryland

G. KENT STEWART
Professor of Educational Administration
Kansas State University
Manhattan, Kansas

JOHN H. TUNSTALL
President
Educational Research Associates, Inc.
Knoxville, Tennessee

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Educational Administration
East Texas State University
Garland, Texas

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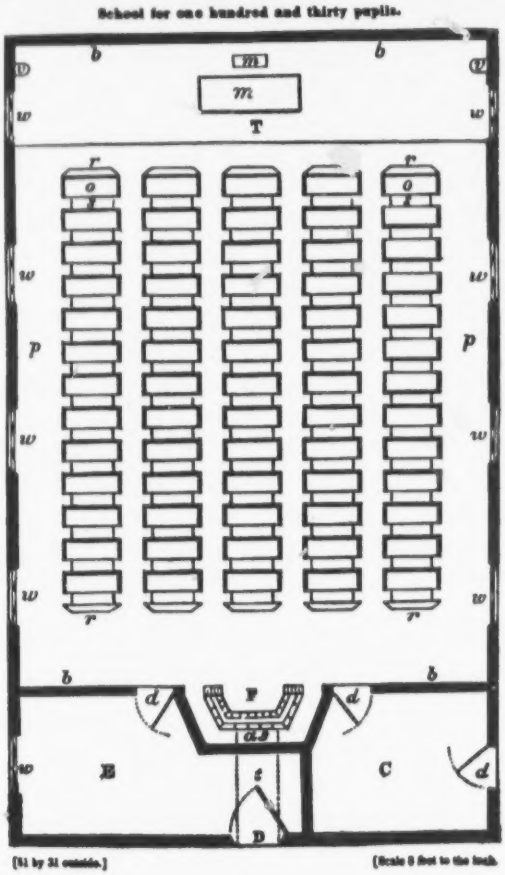
A

HISTORICAL PERSPECTIVE

Boggy Creek Elementary School, Kissimmee, Florida, photo courtesy of Frank Hill.

Interior photo of typical one room school. Courtesy of A. L. Buechner, member CEFPI, Emeritus.



Reproduced from First Report of the Board of Education of the State of Maine: 1847 Publ. by Wm. T. Johnson, Augusta

D. — Entrance door.
E. — Entry.
F. — Fireplace, with air tube, or stove.
C. — Wood closet, or recitation room, or girls' room.
T. — Teacher's platform.
b.b. — Black-boards, &c.
t. — Air tube.
d. — Doors.
m. — Master's table and seat.
p. — Passages.
r. — Recitation seats.
o. — Scholars' desks.
s. — Scholars' seats.
v.v. — Ventilators.
w. — Windows.
a.s. — Air space behind fireplace.

The history of educational planning in the United States and Canada is representative of the responses of people as they have sought to provide for the education of their children. This unit highlights the evolution of the planning process.

The One-Room School

The typical one-room school of the Colonial Period, with its limited space, sparse furnishings, lack of interior sanitary facilities, and poor ventilation, heating and lighting may appear crude by today's standards. This school design was, however, an innovative, practical solution in relation to the times and circumstances. The form of the schoolhouse reflected the perceived function of education.

The Nineteenth Century

The advent of the nineteenth century with its westward expansion, industrial revolution and urbanization gave rise to change. The Eastern United States and Canadian Provinces experienced population increases necessitating a more efficient means of housing the education of more and more students. At the same time, England was experiencing a shortage of master teachers. This gave rise to the development of a school plan by Joseph Lancaster, a British schoolmaster, for one teacher with assistants to instruct up to 500 students simultaneously in one large room measuring some 50 x 100 feet. The idea was adopted in the United States around 1806 and served until about 1840.

Concern for a better educational program led to development of the graded plan with equal sized classes. School planning and architecture responded with the Quincy School constructed in Boston in 1847. This design, described as the "collection of boxes" or the "egg crate" arrangement, was to influence school design for a century or more.

The second half of the 1800s witnessed significant advances in educational programs and in the design of schools. Horace Mann and Henry Barnard, educational leaders of the period, firmly established the principle of form and function in relation to educational programs and the built environment. The quality of school construction improved: brick and stone replaced wood as an accepted building material; desks of various sizes replaced benches; centralized heating systems replaced stoves. Recreational facilities were provided. In addition, learning theories of Heinrich Pestalozzi provided a new direction in elementary education. The value of observation, investigation, discussion, evaluation, self-expression, and the importance of the individual learner were established. New subject matter was introduced. With this growth in learning theory

and increases in subject matter, larger spaces were required. The architectural response was to enlarge the size of the Quincy design, adding an auditorium and a Greek Revival or Victorian facade.

In 1862 the United States Congress passed the Morrill Act, creating land grant colleges in the various states. This resulted in a surge in the planning and construction of college and university facilities.

By 1873 the advent of kindergarten and the secondary school gave new dimension to public education in the United States. The kindergarten movement had spread from Europe. With its emphasis on the development of the individual child, kindergarten teachers quietly began unbolting furniture from the floor and changing traditional concepts of space use and equipment. Secondary schools provided continuing and specialized education for increasing numbers of students. The high school curriculum expanded to include manual training, physical education, the sciences and commerce in addition to college preparatory courses.

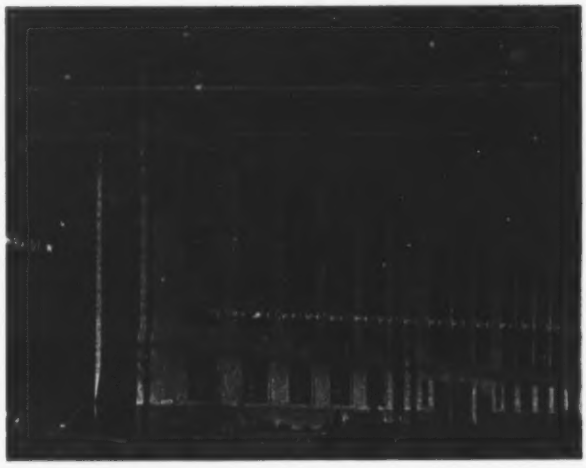
In 1874, the Supreme Court of the United States ruled in the Kalamazoo Case that free schools maintained by locally imposed taxes were legal. The stage was set for education and the concept of the schoolhouse to experience new directions.

The Twentieth Century

The first half of the 1900s saw schools grow in number, size and variety as program offerings expanded and instructional philosophies and strategies changed. By 1917 the federal government in the United States was giving substantial support to both vocational and physical education at the secondary school level. In 1921 Samuel A. Challman of Minnesota, Charles McDermott of New Jersey and Frank H. Woods of New York met in Atlantic City to discuss the formation of an organization to deal with the issues of school plant planning and construction. From this meeting the National Council on Schoolhouse Construction, the parent organization of the Council of Educational Facility Planners, International, was formed. Between 1933 and 1937, the United States government, through the Public Works Administration, became involved in financing school construction. In Europe, Canada and the United States, the 1940s witnessed a move to develop state, federal and provincial building standards.

During the 1950s school construction was a multi-billion dollar effort around the world as school design began to reflect an interest in accommodating more movement, activity and experiential learning. The Quincy "box" was broken as single-story,

Grover Cleveland H.S., St. Louis, Mo., Wm. B. Ittner, Inc.,Architects



Timken Vocational School, Canton, Ohio.
Photo courtesy of the Ohio Historical Society

Teaching-Learning Cluster, Harvey Dunn Elementary School, Sioux Falls, South Dakota. Kroeger, Griffin, Berg, Engineers, Planning Consultants, Sioux Falls, South Dakota.

rambling schools were developed featuring cluster, finger and campus plans. At the same time, new construction materials, including glass, concrete and steel, and new furnishings and teaching aids were affecting the planning, design and construction process. Recreational and athletic facilities became standard school features.

The 1960s. The 1960s ushered in an age of diversity and experimentation in school planning and design. Open spaces, flexible scheduling, carpeting, air conditioning, movable walls, pods and team teaching were but a few of the ideas influencing the period. These innovations were the result of new technology, and also of pervasive changes in the perception of how learning occurs. The concepts of self-direction, spontaneity and individualization gained prominence, and schools changed accordingly to emphasize open, colorful, comfortable and flexible spaces.

A notable advancement of the period was the move to a systems or modular approach to school planning, design and construction. The movement began in England following World War II when new school buildings were needed. Speed and economy of construction were the goals. Prefabrication of components to be assembled into varying designs became the vehicle. This movement reached its peak in the mid-1950s.

Meanwhile several American states were experimenting with "stock" building plans in an effort to reduce costs. This idea, while practical, was not in harmony with one of the pervading concepts of education in the United States: local control of schools. The answer would lie between the single design and construction approach and the "stock" plan approach.

In early 1960 Stanford University and the Ford Foundation's Educational Facilities Laboratory launched a program to develop stock components designed to fit together simply and easily with minimum alterations on the job site. The project, School Construction Systems Development (SCSD), involved educational facility planners, architects, engineers and manufacturers in developing structural systems, light-ceiling systems, HVAC systems and interior partitions. The SCSD system moved school building design and construction into the age of technology.

Another systems program, SEF, was developed in the Toronto Metropolitan School District. SEF made advances in increasing the interchangeability of products from different manufacturers. Other systems arose, notably, the "Project de Recherches in

Amenagements Scalaries" of the Montreal Catholic School Commission, the Academic Building Systems projects of the University of California and Indiana State University, and the Schoolhouse Systems Project of Florida.

The 1970s. Educational planners in the 1970s coped with a new range of complex issues and needs: changing enrollments and the need for new spaces as well as new uses for old spaces; conservation of energy; career education and space needs; extension of the traditional school to new community uses; barrier-free facilities and accommodations for special students; and modernization in a time of soaring costs. An overriding concern was the continuing move to humanize the educational environment.

1980s and beyond. Educational planners will face additional challenges in this final period of the nineteenth century.

- Insuring that facilities respond to programmatic needs and that they are flexible enough to accommodate future programs.

In 1880 Louis Sullivan put into words the guiding principle for the planning of school buildings then, now and for the future: "Form Follows Function." If rigorously followed this simple concept would insure that school buildings encourage the best in teaching and learning.

Computer technology and automated information transmission could make possible the achievement of the one great elusive goal of education, the individualization of instruction. Should the new technology provide a breakthrough, the profession of facility planning will be required to rethink the concept of the school building. Teaching and learning will take on a new character, necessitating radically different forms. It will be an exciting challenge.

- Achieving new building designs for maximum energy efficiency.

In the 1970s America and the world was introduced to a new and present danger, the unreliability of energy and rising costs that threatened to dilute the quality of the educational delivery system. Though this threat passed, reasonable minds comprehended its signal. School buildings in developed countries of the world are perhaps the leading single users of energy outside of transportation and industry. This volume of energy consumption presents two dangers: (1) the unreliability of a constant supply of energy, and (2) the possibility that dollars will be channeled away from instruction and facilities to energy. Planners, designers, constructors

CONTEMPORARY PLANNING ISSUES

Reedy Creek Elementary School, Kissimmee, Florida, courtesy of Frank Hill.

and suppliers of school buildings must plan for maximum efficiency of energy use. Innovation and creativity will be required.

- Coordinating the work of other specialists to achieve an optimal product.

Developing a facility for maximum teaching and learning depends on the input of a number of specialists, not all of whom understand the intricacies of education. The professional planner must coordinate the work of these persons with special expertise. The need persists to continually update the planning process and to improve the performance of planners through careful selection, education and training. Rapid changes affecting the profession emphasize the need for practicing planners to assume responsibility for keeping current through affiliation with professional organizations and through continuing education.

- Engaging the users of educational facilities in the planning process.

The involvement of users in the planning process is a relatively new development whose merits are often ignored. The concept expands the definition of users to include students and the community. Experience has shown that teachers who participate in school planning are better teachers as a result of the process. This same logic can be applied to the other users, students and community.

Participatory planning offers an important challenge for achieving a better quality of education undergirded by strong community support. It will require new insights on the part of planners. Human relations skills will be required along with the ability to establish a constructive interaction among partners with varied and occasionally conflicting interests.

Guidelines for Planning

Educational facilities have evolved from the simple concept of the one-room schoolhouse to the well designed environments that are common today. Better technology, new building materials and techniques, new concepts of design and the evolution of theories and practices of teaching and learning have all played a part in this progression. The critical element, however, has and will continue to be people: educators, facility planning specialists, architects, engineers, social scientists, designers, manufacturers and other experts who are continually working for and achieving improvements in the planning, design, construction and equipping of educational facilities.

This GUIDE is an example of the concern of

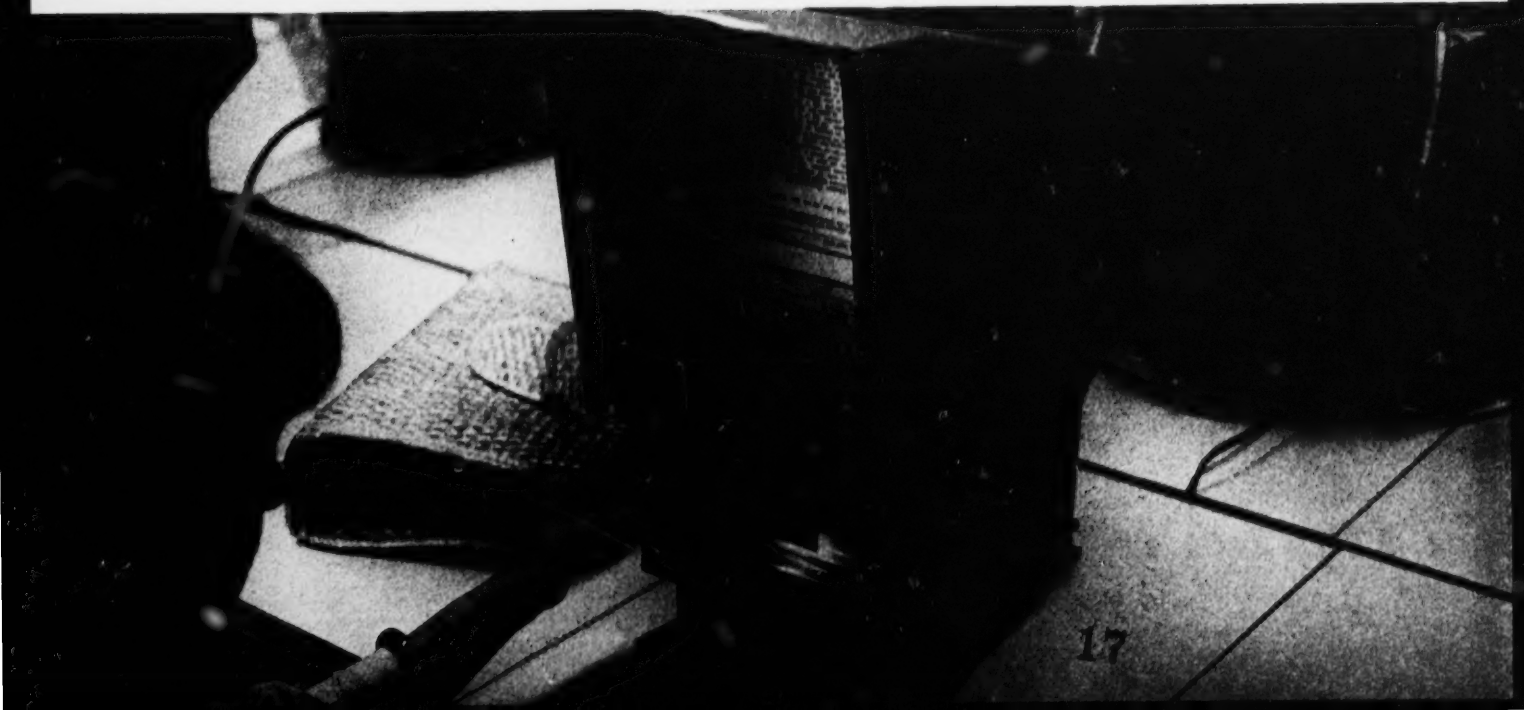
planners to improve the quality of services to education. First published in 1949, the GUIDE has been systematically updated; it constitutes one of the most comprehensive planning tools available today. It is also a tribute to the rich heritage of the Council of Educational Facility Planners, International and its parent organization, the National Council on Schoolhouse Construction.

This GUIDE FOR PLANNING EDUCATIONAL FACILITIES is an authoritative and comprehensive model to be used in the planning of educational buildings from the conception of needs through occupancy and use. Users may be confident that the materials, ideas and suggestions included have met the test of time and can help to insure sound, comprehensive and productive planning and high quality school buildings.

B

PLANNING RESOURCES

Courtesy of Educational Facilities Laboratories, Inc.



Planning Resources

The roles and responsibilities of educational facility planners have expanded in response to the increasingly complex planning process. Fortunately, just as the scope of planning effort has broadened considerably, so has the variety of resources available to assist the planner. It is an important lesson from the past ten to fifteen years that effective school planning cannot, and need not, be accomplished in isolation.

The new era of declining resources and significant social change has forced educational facilities planners to acknowledge what should have been known all along—that schools are related to other institutions and are affected by general societal conditions. Furthermore, because each school exists within a unique milieu, there is no one solution, no definitive facility. Quality is best measured in terms of responsiveness to the needs of the total community, not in terms of an absolute, extrinsic standard. These conditions add a new dimension to the planning process, and those involved in the process need to know of the sources of assistance that are available. It is the purpose of this Unit to describe available planning resources and to indicate how they can be employed.

General Considerations

The term planning resource is used here to designate those individuals, groups, documents, and other sources that contribute meaningful information and thereby facilitate planning by expanding the knowledge with which decisions are made. The resources will be considered according to functional groupings and level of specific involvement. In most cases, placement in a particular category is determined by the type of information that can be provided by the source; that is, engineers provide detailed analysis relevant to a technical problem, whereas research foundations provide a theoretical framework relevant to a general state of the art.

As part of the planning exercise, one of the first steps is to identify the information required for the best possible decisions and then to seek the sources of the information. One of the best places to start in the process is to review the large volume of literature available from a number of professional and academic sources. Following this, further information can be obtained from the sources listed below.

As a result of international information exchanges facilitated by CEFP/I, it is apparent that the planning process and the planning resources do not differ greatly from one country to another. While the planning resources are essentially the same, any particular resource may take on more or less importance from one country to another, just as it does from state to state or school district to school district.

For example, some states and provinces exercise great control over size standards for classrooms and other school spaces. Other states and provinces do not have defined standards and, in may cases, do not have final approval authority over plans for educational facilities. Similarly, the top educational agency in some countries exercises maximum control, while in other countries such an agency is nonexistent or serves merely an advisory function.

The type of resources to be used may also vary according to the type of facility to be built. For example, planners involved in a relocation or replacement of an existing school may rely very heavily on in-house or school related resources, as the would-be users are already known. A new school project, however, may of necessity require greater input from more general and community-wide resources in order to anticipate the requirements of the new clientele.

The terminology used in this Unit is, to a large extent, based on the United States or Canadian vocabulary. The concepts expressed in the discussion of each resource apply to some degree in all school planning processes, regardless of country or the particular labels and titles of resources.

Planning Agents

The board of education, the administrator, and the district staff are the primary school facility planning agents responsible for decision making and the implementation of projects. Other first-line planning agents are those consultants and other technical experts employed by the board to carry out specific functions. But it is the school board and its officials who decide on the extent to which decision making is shared with the community at large and the extent to which the planning resources are allowed to become accessory planning agents.

Policy established by the board of education makes it possible for administrators to organize and carry out an effective planning process. The board can set the stage and establish the climate necessary for viable and creative participatory planning, or it can limit the extent of public

involvement and innovative design. The primary decision makers can decide to use input from a variety of planning resources, or they can opt for a more traditional approach, relying upon a small number of technical resources.

The administrator or superintendent, as the full-time principal decision maker in the school system, must be aware of available planning resources and procedures. In many large districts, however, the administrator may not be immediately and continually involved in the facility planning process due to other management obligations. In such circumstances, the facility planning and building responsibilities are usually assumed by a professional educator, planner, or architect on the district staff. So, the board establishes the framework for facility planning, and the chief administrator or designated official provides leadership and implementaton of the planning process.

District Administrative Resources

There are a number of valuable resources within the local district's administrative unit. It is likely that the identification of facility need will have originated internally, and those closest to the decision makers are often best suited to provide a comprehensive and objective overview of the type of facility required. Many of the district staff can provide valuable input at various stages of the planning process.

Educator-planner. The district may have on the staff a professional planner or educator-planner with some responsibility for educational facilities planning. The extent of direct authority and control over the process may vary according to the district's policies, but the persons with planning expertise can provide invaluable services in terms of coordinating and facilitating planning activities.

These individuals should be able to bridge the gaps among all of the other participants in the process and should have a working knowledge of educational, physical, geographical, financial, and technical factors involved in facility construction. In addition, the educator-planner may have some expertise in a systems approach to planning and problem solving. These individuals can liaise with all of the other planning resources.

Program specialist. Within the school district there are a number of specialists who have valuable knowledge about specific curriculum areas. These individuals can assist in the planning process by providing information on the space requirements and specifications for in-school programs, such as science, physical education, art, and music programs. Such sources can be particularly helpful in translating district or other curriculum standards into the design of physical spaces.

Library specialist. Another area of expertise necessary for the planning and design process is that of the district librarian or library services advisory group. Rapid changes in the role and functioning of school libraries necessitate up-to-date knowledge on the optimal layout of the library and resource center spaces. These individuals can work with the planning and design team to provide a library space flexible enough to handle all of the demands being placed on library services, including multimedia and other technological innovations.

Operations and maintenance superintendent. District officials with responsibilities for these key areas relating to building upkeep and operating costs should be included in the planning and design stage for school facilities. In many cases, these individuals are professonal engineers and are well versed in the building codes as well as in longer-term, cost-saving considerations. Care in the design of facilities can save thousands of dollars annually in routine costs.

In addition to making recommendations on overrall efficiency, these individuals can provide valuable inputs on other emerging design concerns. For example, energy conservation matters and appropriate heating/cooling systems can be developed with the help from these resources. Further, these individuals are knowledgeable in areas related to security and vandalism prevention. Operations and maintenance personnel should be directly involved in most aspects of the facility planning process.

Business administration and financial analysts. The high costs of new construction, land assembly, consultants, and renovations dictate that the financial aspects of new construction be handled carefully. The district business manager or administrative head, or the individual responsible for financial matters, is involved in the collection and disbursement of funds. As such, this individual works with the planning team and provides input on fiscal and legal restraints. This individual helps to ensure that the product of the planning process is financially possible and within the approved budgetary guidelines.

School Related Resources

Resources available through an existing school approximate the concerns of the potential user group for a new facility. These resources draw upon their first-hand knowledge of the pros and cons of the existing school organization and design. While these resources are not likely to represent the clientele of a new school, they may be the same users who will occupy an expansion, replacement, or relocation of an existing school, or a new school in a similar neighborhood. These resources can provide varying degrees of input according to their direct relationship to the facility under consideration. The groups in this category have a right to comment on aspects of an environment in which they will spend considerable time working, learning, and playing. If the users are ignored by excluding them from the planning process, it is a waste of valuable resources that could have serious consequences. The school could be uncomfortable and inconvenient; worse, the facility could be abused due to hostility or lack of caring; worst, the absence of choice has an alienating effect on the inhabitants.

Principal, head teacher, administrator. All those who have had direct responsibility for managing a school facility have valuable insights to offer to the planning process. The principal has practical knowledge of all aspects of the school operation, including classroom use and organization, specialty areas, public acceptance, working conditions, equipment, internal circulation, and scheduling. School administrators present a management perspective that is useful input to both the general and specific design features.

Instructional staff. The instructional staff use existing facilities on an almost daily basis, and the immediacy of this involvement makes the faculty an excellent planning resource. Instructors can assist in the development of an educational program and its translation into a facility plan. They should have an opportunity to discuss various aspects of the design and education specification with the project coordinators and the architects. In order to enhance their awareness of design possibilities and to increase their advisory capabilities, it is important that the instructional staff be given an opportunity to learn what is being done elsewhere. As the instructional staff is occupied with the daily challenge of teaching, it is only natural that many will confine their comments to such things as more chalk boards or better parking facilities. By exposing the staff to different trends, practices, and spaces in educational facilities, an open dialogue where ideas flow can be created to make the planning process meaningful.

Support staff. This category includes all persons who contribute to the school services and activities not formally identified with the instructional program. Although it will vary by district and by school, the support staff includes clerical services, plant maintenance and operations, food services, health and safety, and storage. The individuals can provide insight into factors such as student flow, security, equipment selection, and safety. Information from these resources is critical to an efficient design of ancillary spaces vital to the functioning of the school.

Students. Until recently, students have been an underused resource in spite of the fact they constitute the largest user group. They should have an opportunity, in much the same way as the instructional staff, to comment on those aspects of design that lead to a comfortable and stimulating educational environment. Student ideas and needs belong in the planning process; it is, after all, for them that the schools exist.

Students, as full-time users, have insights into the design, furnishings, lighting, and other aspects of school spaces. The students use facilities for a variety of purposes—educational, social, recreational—and can offer clues to the overall school environment. In practice, however, students often lose interest in the planning process because they feel they are being merely tolerated. To capitalize on this resource and all other participant groups, the planners must carefully involve and accommodate those invited to be active in the process.

P.T.A. and consultative committees. In many school systems, each school has its own parents' group, which acts in an advisory capacity to the local school administrators. These groups are often overlooked in the planning process because of their narrow base of support. However, the organized parents' group can offer a perspective on the broad role of the school in the neighborhood as well as that of a particular interest group. As taxpayers and individuals concerned about the effectiveness of the school facility, the local parents represent important elements in both the design and community acceptance states of the planning process.

The community. Citizen participation has become recognized as a valuable contribution to educational facility planning, especially in the formulation of educational goals and objectives. The planning of community schools should include input from the local community, representing either the existing catchment area or the proposed new catchment area. Local residents are in touch with the community's needs and can assist the planner in translating these concerns into the facility design. The planner should incorporate general space criteria with the specific needs of the community.

In some school districts, community involvement in the planning process is a policy that leads to public knowledge, concern, understanding, and support. In many countries, various school districts have a large proportion of older citizens, and this segment of the population is growing. Using representatives and advisory groups from the entire community, not just those with school age children, provides local support for education and ensures that the school operates fully as a community resource.

Educational Resources

There are a number of general resources available to provide a broad perspective on new trends and innovations in the design of educational facilities. As new insights into the educational process are discovered, the application of changes in learning theory and techniques often requires changes in the character of school plans. In some school districts, the advice from these sophisticated educational resources is an integral part of the planning process. The information produced by these sources is available in a number of forms, and the input required can be obtained to fit the scope, timing, and budget of most planning exercises.

Professional associations. This group includes membership organizations that provide a vehicle for information sharing among professionals in areas related both directly and indirectly to facility planning. Groups such as CEFP/I, the National Association of Secondary School Principals (NASSP), the Canadian Education Association (CEA), and the American Association of School Administrators (AASA) can be contacted for a number of resource services. In addition to publishing journals and newsletters that include items on facilities planning, they sponsor conferences, exhibits, and seminars, produce films and other media aids, and encourage research on a variety of related topics.

Educational Consultants. Educational consultants are those persons who specialize in various aspects of planning from curriculum to finance and who understand how to implement and coordinate an effective planning process. They can provide objectivity and fresh thinking to local school districts as well as expertise on specific concerns. Some consultants operate independently while others are affiliated with consulting firms, universities, and government agencies. They can usually be identified by other school administrators, professional associations, and foundations. Outside consultants can be especially effective in working with the community involvement process. However, before a contract between the consultant and school administrative unit is formalized, roles and expectations of both parties should be thoroughly and clearly defined and the potential for an amicable working relationship well established.

Regional, state, and provincial education agencies. Personnel from regional and state or provincial education agencies, especially those persons within the school facilities sections, may serve as consultants to local school districts and participate actively in the planning process. Occasionally such agencies have a regulatory function, and often they must review architectural plans prior to construction to determine that a proposed project conforms to established standards. These agencies often provide financial assistance and require efficiencies and controls in the facility design. Staff from these agencies are able to condense experiences from a number of districts into practical advice for each new project.

Universities and colleges. Faculties of education and related disciplines at both colleges and universities are useful planning resources. Academic staff and students are often interested in providing assistance to local school districts, both as a practical application of theoretical studies and as a part of continuing research. Some institutions have field service staffs to assist local education agencies. The courses taught in these programs related to educational facility planning can provide useful in-service training to district planning agents, and the local board can use this resource by offering internship positions for graduate students.

Research agencies and institutions. Valuable information on educational facilities is available through a few specialized research agencies and institutions. Organizations such as Educational Facilities Laboratories, Inc. (EFL), help school

districts by supporting studies and by disseminating information in a practical format to help local planning efforts. Some of these resources are affiliated with universities, and some operate independently. These agencies promote research and innovation and often provide the necessary encouragement for local experimentation.

Technical and Legal Resources

Each educational facility project requires an extensive array of inputs from highly specialized technical consultants. These professional resources are required not only in the preliminary stages of planning, but also throughout the rest of the project period, including detailed design, property acquisition, tender and contract preparation, construction, and operation. As these resources are involved in all types of construction projects, their technical expertise is not restricted to educational projects. However, some may have more experience in school projects than others. The planning team will have to determine throughout the process when and if certain specialists will be required or if some of the technical matters can be resolved in other ways.

Architects. The architect's role is detailed in Unit D. In brief, his or her job is to translate the educational program into design concepts that are developed in the building plans and specifications. The architect may function in an advisory capacity during the districtwide survey, site selection and educational planning phases. The architect may be responsible for supervision of construction. In those districts that have a permanent architect on the staff, the role assignment may be very comprehensive. If an outside architect is retained, the selection of such a person should be based on the capability of the architect to undertake all of the duties required.

Even after completion of the project, the architect should work with the planning team on a post-occupancy evaluation program. This is especially important where the school remodeling or construction is a continuing/phased process.

Engineers. There are a number of consulting engineers who are specialists in areas such as land surveys, soils analysis, structural design of buildings, lighting, plumbing, heating, ventilation, air conditioning, seismic loading, and acoustics. These resources provide technical expertise to the architect and/or the general contractor.

Engineers and contractors can provide assistance in determining the feasibility of renovating existing facilities. For new construction projects, they may suggest alternative materials, equipment, and construction techniques and assist in the preparation of cost estimates. It is mutually advantageous for the engineers to participate in the planning process so that they can contribute their expertise and become familiar with the personnel, problems, issues, and goals relative to the project.

Legal counsel. Many school districts employ full-time legal counsel and others retain the services of counsel. For districts without access to this service, it is necesary to hire such technical expertise during the planning and construction process for a new school facility. It is a fact of modern life that legal counsel is often required for even simple transactions, let alone a complex building project.

It is sometimes desirable and often necessary for legal services to include advice and preparation of necessary documents related to the issuance of bonds or other means required to finance the school project. Financial matters, especially when applied to tax-supported school districts, may require careful compliance with all legal procedures. The same may be true for the preparation of all documents that accompany a building program. Legal counsel may also be required for property acquisition, contract preparation for design and construction, and definition of liability and other responsibilities.

Assessment and land agencies. Growing school systems with an extensive building program may consider employing a full-time land agent to acquire properties. Such help is especially needed in developed urban areas where many parcels of land are required to put together a site. For those districts that require a new site only periodically, the services provided by these resources can be obtained early in the process to help with the planning and to begin the necessary activities. These individuals provide useful services such as property evaluation and assessment, securing options, legal descriptions, preliminary title searches, and other details of site acquisition vital to a successful building program.

Construction manager, contractor. The construction manager or general contractor works with the school district staff and the architect to bring the project to completion. Many of these resources give the owner a bonded maximum price within the project budget, thereby controlling plans, costs, and scheduling from the outset. The manager or contractor analyzes the design feasibility and develops estimates based upon a

working knowledge of construction costs. Suggestions for design change may be made to affect cost and/or time savings. The close working relationships among the owner, architect, and manager/contractor are necessary from the first planning stages to completion of the project, and each party should be aware of the distribution of responsibilities before entering into any agreement.

Equipment and furniture suppliers. The selection of school equipment and furniture is an integral part of the planning process and has broad and long-lasting implications for the users of the facility. Space requirements for certain types of equipment and furniture may affect the internal design of the school. Conversely, the programming needs of the school and their related spaces may affect the choice of furnishings. In either case, the suppliers can act as resource persons for matching needs, spaces, and equipment.

School equipment suppliers and planners are often required on the staff in large systems with extensive building programs. Outside consultants are also available. Assistance can also be obtained from manufacturers' representatives. Although equipment and supplies are required near the completion of a project, the suppliers and planners should be involved during the early planning stages to understand the needs of the proposed educational program.

Other technical specialists. In addition to the more obvious technical resources, there are a number of experts in newly emerging specialty areas. These resources may be tapped to resolve particular problems or to advise on unique projects. For example, experts in security services may provide input into an antivandalism program associated with the school design. Or, energy conservation consultants may work with the planning team to help design an energy-efficient and innovative facility. Transportation consultants may be required to assist with design problems related to transit, parking, and traffic. If a particular aspect of the planning process is taxing the planning resources, there are probably experts available to help in the resolution of the problem.

Community Planning Resources

The local area setting for a specific school project can be provided by community planning resources. There are a number of public and private agencies that are involved in local planning matters. These resources can provide background information on the general direction of community growth and development, as well as specific information on the socioeconomic characteristics of neighborhood or household populations.

This category includes a wide range of possible sources, not all of which may exist in a school district. Generally, one or two of the sources may provide the needed input into the planning process. There will always be some overlap in the information that can obtained from these orrganizations or agencies. The extent of involvement in the planning exercise by many of these groups will be determined by the scope of the project.

Local planning agencies, commissions, and departments. The local planning commission or an other formal planning agency is an excellent source of data vital to the school planning process. Information can be obtained on land use and zoning, housing projects, demographic and economic shifts, parks and recreation expansions, transportation proposals, annexations, consolidations, and other community changes that may affect the school system or a particular school project. The planning agency can provide both quantitative and qualitative data, and representatives of these organizations should be involved from the earliest stages of a school planning exercise.

Rapid changes in a community can render educational facilities planning obsolete if careful coordination is not achieved with local planning authorities. These resources will be able to recognize those housing projects that are likely to produce school children and those that will accommodate singles or retired persons. Even though the school district boundaries may not be the same as the planning commission boundaries, the planning authorities generally have a far-reaching awareness of all aspects of community growth, decline, and change.

Regional planning agencies and commissions. The resources in this category may offer types of information similar to that of the local authorities. However, the planning jurisdiction is usually larger and takes into consideration the longer-term development prospects of a number of areas. The regional boundaries may provide detailed insights into matters such as transit systems, highways, industrial developments, residential subdivisions, parks, hospitals, airports, resource industries, and utility projects. Contact with the regional planning agencies should be maintained

to provide a broad contact for the planning of new school facilities.

Civic departments. Important local resources include all of the civic departments and the protection services. City and county governments offer a variety of expertise through a number of departments. For example, a city engineering department can provide data on water and sewer connections, streets, garbage collection, lighting, and other aspects of the physical infrastructure associated with a school project. Usually, a civic department is responsible for issuing permits and building licenses. The local department of parks and recreation can be a valuable source of information, especially for data on the composition of the local community and on the inventory of leisure services and facilities.

The standard protection services are often eager to participate in the planning process. Since the well-being of children is an important goal in all neighborhoods, the local health, fire, and police departments all have interests in school projects. Schools are visible and highly respected institutions in most communities, and the protection service departments often use the facilities for local awareness programs. These departments can provide advice on specific design aspects of the schools relevant to their particular concerns.

Local service agencies. Many communities and school districts have a range of nonprofit and public service agencies that can contribute to the school planning process. Some social service organizations, such as United Way, may have separate research departments to gather valuable socioeconomic data on the community. Other service agencies or departments can provide information on matters relating to health, welfare, pensions, workers' compensation, adult education, day care, group homes, and the handicapped.

The sources in this category are knowledgeable about specific interest groups that may become part of the proposed school's clientele. The specific needs of these interest groups may form a necessary part of the facility design. In addition, nonschool programs sponsored by these agencies may form a part of the community service orientation of the school. As the merits of multiple-use buildings are now being realized, the local school district may consider ways of integrating educational services with a full range of other public services. The school may include provision for day care, health services, adult education, and other programs, based on input from the local service agencies.

Residential development resources. A key component in the development of a viable educational facilities plan is knowledge of the potential students and other user groups. This information can be obtained directly from a number of resources involved in the residential development industry. Included in this group are builders, developers, financial institutions, real estate associations, cooperative housing societies, and tenants' groups. These resources contribute to the overall understanding of the existing or proposed catchment area.

Contact with these resources may be established early in the planning process when the size and time table for a new facility are being discussed. Follow-up data as required may include family size and composition, housing types, density levels, market costs, rental rates, proportion of assisted or social housing, development schedules, and take-up rates. These resources generally will provide as much information as needed to the planning process because of the important role schools play in the quality and viability of a residential area.

Planning and development consultants. Another local resource that may be used to good advantage is the planning and/or development consultant. These individuals may be able to provide guidance on the use of a successful planning process and on the best means of obtaining necessary municipal permits or approvals. Further, these resources can be hired to provide the planning team with the desired community inventory data. Consultants may also have expertise on the development of planning programs that can bring the project to completion on schedule. In many cases, the extra costs for these specialists result in savings in the long run.

Other local resources. There are a number of potential sources that may contribute assistance on a variety of local concerns. For example, there are traffic and transportation specialists available to provide details on site access problems. In some older urban areas there are heritage advisory groups able to discuss the possible implications of any changes to designated heritage schools. The media, local church groups, business associations, and local public utility companies can all be approached for information on specific details about the local community.

General Resources

At the most general level, there are agencies, departments, commissions, foundations, and

other organizations of national or international prominence that can supply directional, jurisdictional or financial support to the educational facilities planning process.

While some of the resources exert control over the local effort, most of them are limited to theoretical advice and support. Many institutions at this level present state-of-the-art concepts that may be applicable to any given school planning project. Not all of the resources available in this group will be useful for a routine school project, but there are some international projects and new district programs that can benefit directly from this type of expertise.

Federal government agencies and departments. In some countries, educational responsibilities fall under federal jurisdiction, while in others the federal government plays only a minor or indirect role. CEFP/I maintains information on the appropriate agencies in most countries.

In most cases, the responsible federal agency or department provides a transfer payment to support local educational activities. When education is controlled at the national level, then any local planning efforts must use the basic facilities guidelines as directed by the federal agency. When the control over educational services is at the state or regional level, federal input may be very limited.

In both the United States and Canada, the primary responsibilty for education is at the state or provincial level. Federal programs for planning and constructing school facilities are now extremely limited and it appears that none are forthcoming. Federal sources do not provide direct financial or personnel assistance to local education agencies. Some agencies administer programs with direct implications for facility planning, such as the U.S. Department of Education and the Secretary of State of Canada. Other federal departments may have indirect implications for school buildings. In Canada, for example, most local building standards must be equal to, or greater than, those contained in the federal government's National Building Code.

State and provincial departments. In addition to the state and provincial departments with direct responsibility for education, there are usually some other agencies or departments at this level with some effect on local school facilities planning. These groups may perform functions similar to those of the local planning commission, except they serve a larger geographical area. For example, certain departments may have jurisdictional control over any construction on flood plains, agricultural land, coastal or forest lands, or park reserves. They are often involved in the development of long-range goals that may have implications for local school projects. Because school planning cannot be disassociated from planning considerations related to other interests and spaces, it is both expedient and beneficial to establish communications with such planning agencies. Although contact and information exchange with these groups are appropriate to the planning process, do not expect these agencies to make decisions for the local project.

State or provincial commissioners responsible for services such as fire prevention, water supply, and utility controls may also participate in the planning process. These agencies may review proposed building plans and disseminate guidelines specifying mandatory requirements. In districts without local agencies to perform these functions, state or provincial representatives may be involved to implement zoning regulations, building restrictions, fire and safety regulations, and other controls. The project architect should be aware of the appropriate levels of approvals.

National and international professional associations. This group includes membership organizations (such as CEFP/I) that offer a worldwide perspective on matters relating to education and school facilities. As indicated earlier in the discussion of education resources, many professional associations actively promote information exchanges and encourage research that has implications for facilities planning. Some of these associations provide technical expertise on matters relating to all types of construction and include such groups, in the United States, as the National Board of Fire Underwriters and the Illuminating Engineering Society. These organizations generally maintain information on their counterparts in other parts of the world.

International agencies. Although the work of these resources is primarily directed to developing countries, there may be some transferable data applicable to school projects in industrialized countries. Organizations such as UNESCO and the World Bank have been responsible for upgrading facilities and improving the quality of construction in educational systems throughout the developing world. By providing funding, trained personnel, support materials, and

commitment these organizations have become adept at planning and implementing a variety of educational facilities projects. Some of this expertise may be tapped through a variety of media sources available from these agencies.

This Unit is not an exhaustive catalogue of planning resources. Rather, it points out the types of resources that may be used during the entire project period. The Unit does, however, provide an overview of various sources of assistance and guidance available to those involved in the planning process. The services can help to: (a) ascertain that the planned facility is what, where, and how much a community needs, (b) learn about current design, educational and technological innovations, (c) assure that the buildings to be constructed conform to legislated standards, and (d) determine the financial and practical feasibility of the project. Ways to use many of these resources will be discussed in later Units.

It is probably safe to state that the quality of a planned facility is more dependent on how these resources benefit each project, rather than on how many or which resources are used. The planning team must be discriminate in choosing from the wide range of possible sources. Each resource must be evaluated in terms of its potential costs and benefits and then used intelligently and sensitively by the cooperating planners. In most cases, the planning process is limited by time, personnel and financial constraints, and the available resources must be used wisely to provide the maximum amount of input necessary to make the best possible planning decisions.

C

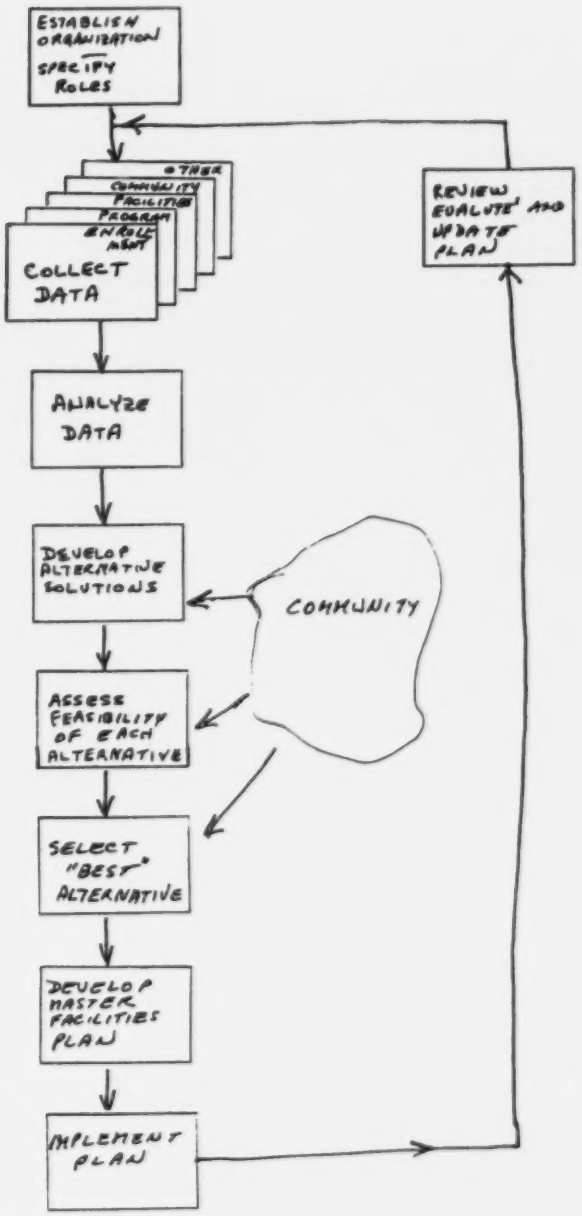
DEVELOPING A MASTER PLAN

CONSENSUS-COMMITMENT

Pictures of people are from a charette held in Camden, NJ. Photos from Frank Johnson.

Master Planning Process

Figure 1



Development and use of a facilities master plan is the key to providing and managing high quality educational space whether it involves building, buying, renovating, closing, leasing or selling. This plan is developed through the integrated efforts of people with a variety of skills such as educational facility planners, architects, educators, community members and engineers. Others may be involved as particular problems emerge and are dealt with.

Responsibility for development of a facilities master plan resides primarily with the educational facility planner. This individual is often an educational administrator with special technical skills that provide for an understanding of the complexities of contemporary educational facilities and enable communication with, and coordination of, a variety of specially trained professionals. It is the educational facility planner who provides for continuity on a project from the planning stage to the design stage, through the occupancy stage, and on into the evaluation and feedback stage, which can often initiate a new or revised facilities master plan. This unit describes how the facilities master plan is developed. The process can be broken down into nine steps:

1. Establish an organization and specify the roles and responsibilities.
2. Collect data about such factors as enrollments, facilities, community expectations and the educational program.
3. Analyze the collected data and identify trends, directions and goals.
4. Develop alternative ways of achieving the ends identified by analysis of collected data.*
5. Assess the feasibility of each identified alternative.*
6. Select the preferred or "best" alternative(s).*
7. Develop a facilities master plan to achieve the chosen alternative(s).
8. Implement the plan, provide the required facilities, and put the developed facilities into use.
9. Evaluate the completed facilities and initiate an update of the facilities master plan.

*Involving the community in this step may gain greater acceptance for the selected alternative.

The following questions may be asked to elicit information that will aid in the development of the facilities master plan.

- What are the trends that will influence educational facilities in the future (e.g. computers)? How will the impacts be felt?

- How do the board's facility policies and procedures relate to current needs?
- What do enrollment projections predict as enrollment levels for the attendance area(s) under review?
- What are the current levels of investment in facilities? What is the condition of these investments?
- How will emerging management information systems influence development and implementation of a facilities master plan?
- How can an energy conservation plan be incorporated into a facilities master plan?
- Is it possible to systematically review facility requirements so that the least needed space is disposed of and unused space is kept to a minimum?
- How can the community be involved in the facility planning process?
- How can information be communicated to boards to assist them in facility management decisions?

Answers to these and other questions will yield detailed data that must be categorized and stored for analysis. The availability of relatively inexpensive stand-alone computer hardware means that even the smallest districts can afford some form of information management.

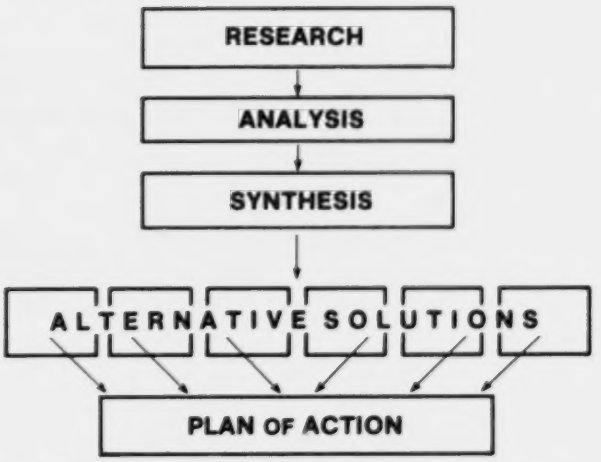
Following the proposed steps and asking the necessary questions should aid the educational facility planner in developing a facilities master plan with these features:

- Analysis of the community's or campus's characteristics and particular educational needs.
- Determination of student population and characteristics.
- Description of the educational program.
- Appraisal of the educational and structural adequacy of facilities.
- Assessment of financial resources.
- Formulation of specific recommendations.

The Community Analysis

An integral part of educational planning is an analysis of the community or campus, including a documentation of its history, an assessment of its present status, and a projection of its future character. In preparing the community analysis, an effort should be made to determine what citizens expect from the school (its reputation) and what their educational needs are. At the college or university level the same applies; the "community" must be identified and a clear statement of the role of the institution developed.

Figure 2



Comprehensive Educational Survey

Traffic — Grand Rapids, Michigan, July 31, 1984. Compliments of John Sampson.

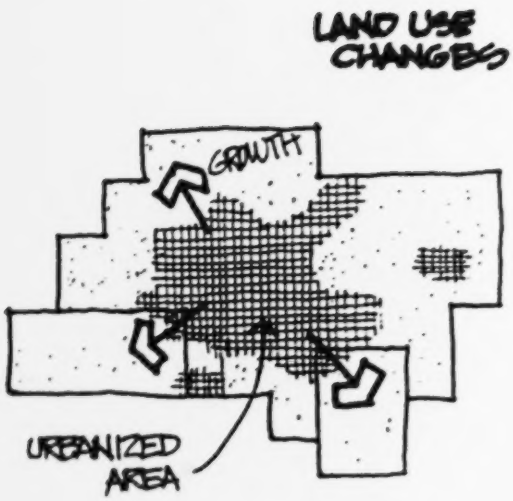


Figure 3

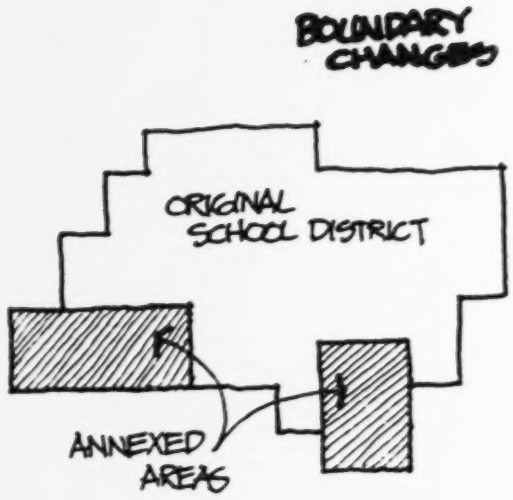


Figure 4

A survey of a community's history provides a background against which present conditions acquire meaning. The following are examples of community characteristics that may require examination.

- Population characteristics and density patterns.
- Population changes due to in- and out-migration patterns and to fluctuations in the birth rate.
- Changes in land usage (residential, commercial and industrial).
- Major highway and street networks and their probable future development.
- Changes in socio-economic patterns and needs resulting from population shifts within the community and other community changes.
- Geographical limitations.
- Condition and value of housing in residential areas and of commercial buildings in industrial areas. Alternate uses of areas should be considered in all planning stages.
- Availability of community services—libraries, recreational areas, health services, public assembly space, etc.
- Vocational opportunities in the community.
- Parental expectations of the schools.
- Citizen attitudes and aspirations in general.
- Possible shifts in housing patterns due to attitudes about racial integration.
- Changes in school district boundaries.
- Identity of the clients. What are their potential needs?

Communities are so complex and their suborganizations so interdependent that a major decision made in one segment may affect others. For example, the conversion of residential land to industrial use may isolate school buildings or otherwise place them in an undesirable educational environment. Freeway systems occasionally slash through school administrative units causing unsatisfactory attendance boundary changes and producing problems for the school transportation system. The rapid movement of population into or out of the district or neighborhood can bring about a crisis situation. Declining population and a corresponding drop in school enrollment can result in underused and unneeded school buildings.

For these reasons, as well as many not identified, no facilities master plan is complete without an overview of the total community. Much of the needed data can be obtained from school records and from other public agencies and institutions. While some information may require computer analysis, other information, especially that related to attitudes, can

be collected by a survey implemented by community groups.

School Enrollment Study

Developing data on school enrollment is a topic that deserves special consideration because of its technical complexity and because enrollment figures are concerned with a particular population segment.

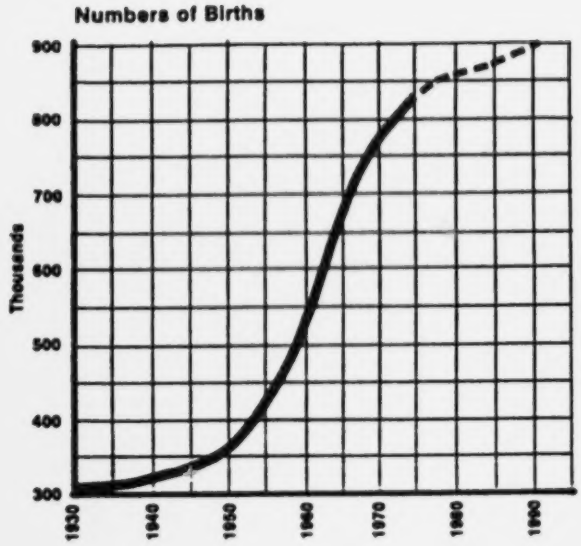
In general, the following statistics are useful components of the plan: population trends of the total school community, birth rates and the number of births, public school enrollment figures, non-public school enrollment figures, holding power of public schools, and housing patterns.

The school census is an important record that can be used in assessing educational facility needs. A continuous, complete census system is invaluable in providing insights into many of the factors affecting future public school enrollments. A word of caution: school census data have in some cases been notoriously inaccurate mainly due to the slipshod methods of data collection. A poor census, as is true of other data, is worse than none at all.

Historically, long-range projections have been unreliable. In the 1930s enrollment increases that were to occur during the 1950s were not foreseen. Likewise, the declining birth rate (resulting from the appeal of the birth control pill and "zero population growth") which affected enrollments in the 1970s was not predicted. Trends now seem to be pointing to an echo of the post-war baby boom. Enrollments may climb during the 1980s. It is therefore imperative that school administrators annually update population and enrollment projections so that changing conditions can be identified and their effects anticipated. Even under the best of circumstances it is difficult to anticipate changes. Newer, more sophisticated technology may make the task easier.

Before studying various methods of enrollment projection, some of the factors that affect the projections should be discussed. The method used to project enrollment should be determined by the particular set of circumstances of the district involved in order to obtain the highest possible level of accuracy.

Changing economic conditions. Population growth or decline in a given community is often related to changing economic conditions. Such factors as urban renewal or new housing developments affect migration into, out of, or within school administrative units. Analyses of these factors may require the



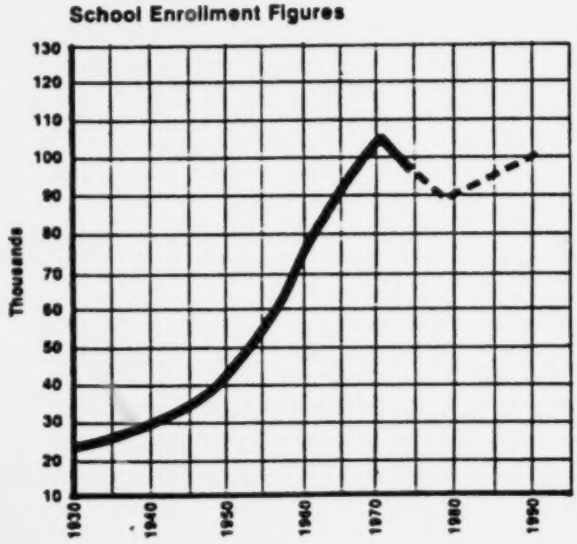


Figure 5

help of specialists, such as city or regional planners, and should be current to insure the validity of estimates and their effect on enrollment projections.

High costs, escalating interest rates and the energy crisis are a few elements that have reduced mobility and have affected enrollments in city and suburban schools. Suburban school district pupil populations had been increasing at tremendous rates during the 1960s, whereas inner city districts had been decreasing at even greater rates. By the 1980s both had experienced almost stabilized enrollments, and in some cases the growth trend actually reversed.

Non-resident and non-public school students. Public school enrollments in many districts have often been dramatically affected by the transfer of non-resident pupils from nearby districts. Policies concerning acceptance of non-resident pupils can substantially affect enrollment forecasts. Similarly, any significant change in the percentage of the total number of children in the district who attend non-public schools will have an impact on future planning.

Boundary changes. School district boundary changes, resulting from court orders, district reorganization, annexation, or consolidation of territory affect enrollment projections. Likewise, the growth of city school districts that depend on annexation is often thwarted by suburban areas that have become incorporated cities or towns with separate school systems.

Pupil dropout/retention/acceleration. Patterns of pupil dropout/retention/acceleration may be analyzed in estimating future pupil load. In theory, total school enrollments should be increased by retentions and decreased by accelerations and dropouts. However, retentions often stimulate pupil dropout and ultimately tend to decrease total enrollment. Changing promotion policies alter projections based exclusively on analyses of past practices. This is, of course, true of any policy change.

Land-use changes. Changing land-use patterns influence enrollment projections for all types of school districts. This is most obvious when farm land is converted into lots for home development, or, to the contrary, when existing housing is leveled for new highways or renewal projects.

Type of housing. The cost and type of residential dwellings will often affect school enrollment as much as, or more than, the number of houses constructed in a given area. Studies have demonstrated a close relationship between school enrollments and the number of bedrooms in each family unit. Although two-bedroom homes often produce a high

preschool density, the movement in and out of such homes due to increasing affluence and growing family size seldom produces in-school densities as high as the preschool densities suggest.

Projecting future enrollments. Several methods, none of which are highly accurate, have been devised for projecting school enrollments directly from basic data, i.e., birth rates, migration patterns, mobility within administrative units, and other factors previously discussed. Other methods are based on an estimate of the total population from which school enrollments are deduced. Some common approaches to enrollment forecasting are described below:

1. One projection technique emphasizes an *analysis of census data.* Past census data are examined to ascertain either the rate of change or the average increment of change over a given period of study. The major criticism of this approach is that it ignores the possibility that one or more of the factors that produced changes in the past may no longer be operative.
2. Another typical approach to estimating future enrollments is based on *analogy.* It is assumed that if two districts are similar, then what happened in one will occur in the other. The flaw is the difficulty in identifying comparable communities.
3. *Relating school enrollment to total population* is another way to form estimates. Total population projections are often more difficult to compute than those for school enrollments alone. This procedure, therefore, is used primarily when total population projections are available from other sources. The actual ratio used in such projections is sometimes determined by analysis of the existing or past census data or by analogy with other districts. This method can be valuable for long-term projections, but it is seldom sufficiently reliable for short-term projections. Of course, its accuracy is directly related to the accuracy of the basic total population projection.
4. *The average survival ratio technique* is probably used most often to project enrollments. It uses historical data, but it modifies this data in light of new trends. This procedure tends to lump together most factors affecting future enrollments except birth rates, which are treated independently. It is best used for short-term projections. It is unreliable for rapidly growing districts unless it is used as a starting point for multiple-factor analysis.

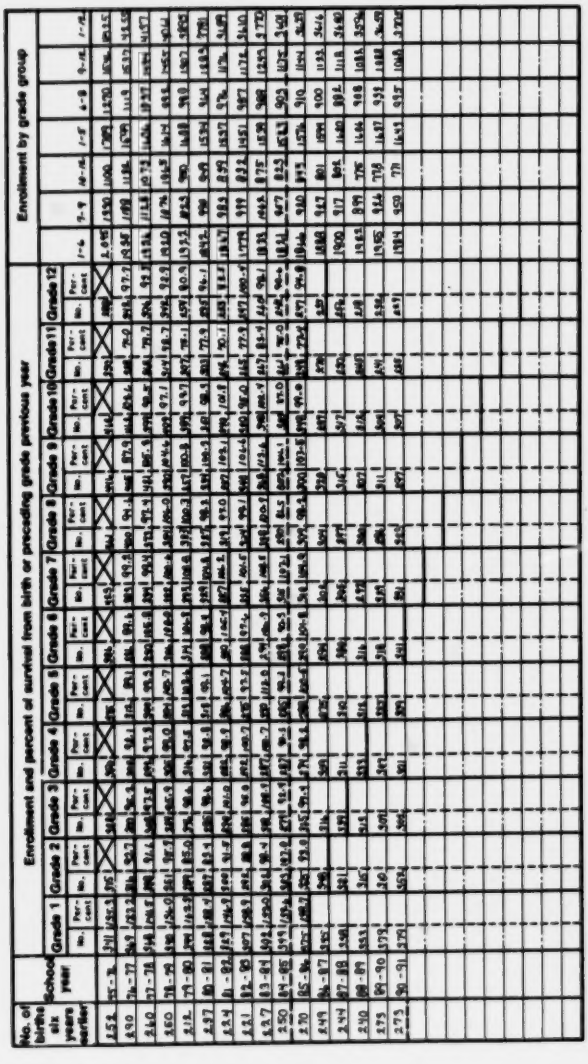


Figure 6

The average survival ratio method compares birth data for a given year with public school enrollments in kindergarten or grade one some five or six years later. It then compares numbers of pupils in one grade with those in the next higher grade one year later. With birth data already available for groups who will enter the public schools for the next five or six years, first grade enrollments are projected by applying the average ratio obtained from the historical analysis. The average survival ratio should be adjusted to take into account specific trends easily identified by individual analysis. For example, in rapidly growing communities, the effect of in-migration can be more accurately projected as an additive factor based upon projected new home construction.

5. *Saturation analysis* projects the school enrollment that might result if all the land in the district were completely developed. These studies are particularly important in determining long-range plans in urban areas where site requirements must be established before building to insure adequate sites without the expense of purchasing developed land. Because the saturation study requires knowledge of land-use patterns, the involvement of city planning experts is particularly important. Basically, the procedure is to ascertain the number of acres likely to be used for residential purposes. It is important to consider land allocated for parks, roads, schools, and other community facilities. The probable residential areas must then be translated into probable dwelling units at the time of total development, taking into account existing and probable zoning regulations. The nature of the land may result in development that far exceeds minimum zoning regulations. The probable number of dwelling units is then multiplied by an estimated ratio of pupils per dwelling unit to determine the probable school enrollment at the time of saturation. Pupil density ratios (pupils per dwelling unit) vary considerably from one district to another as well as within districts.

The factors mentioned in connection with other enrollment projections are also considered in the analysis and determination of probable future density ratios. Aging of communities is another influencing factor. District-wide density cannot be used for saturation studies because housing developments vary in pupil density ratios.

It should be clear that projections depend in whole

or in part upon past conditions. They thus rely on the continuation of past trends for accuracy. All projections are a form of probability statement.

When pupil populations are projected, it is usually wise to bracket enrollments rather than to give one estimate. The *dual projection procedure* brackets the target figure by using one set of assumptions that may result in low estimates and another set that may result in high estimates. These two sets of assumptions are usually more defensible than a single set because conflicting trends affecting future enrollments may cancel each other. Since long-range plans call for enough flexibility to satisfy the realization of either high or low enrollment estimates, the dual projection procedure serves a useful purpose.

The assumptions selected should not result in absurdly high or low projections. It should also be emphasized that the dual projection procedure does not eliminate the need for detailed analysis of factors that affect future school enrollments but that are not part of the assumptions. The approach should not be used to make two "best" projections of probable enrollments, but rather to bracket the target with an estimate that may exceed actual future enrollments and another that may be lower. Unless the bracketing concept is understood clearly, dual or multiple projections only confuse the issue and make planning more difficult.

The Educational Plan

The educational plan is that section of the facilities plan that describes in general the community's educational philosophy. It also defines the purpose of the school or institution and the policies and practices surrounding the program implementation.

Educational philosophy. All aspects of educational philosophy, purpose and policy should be discussed by community, staff and student representatives as well as by professional planners, consultants, and others whose special knowledge can be helpful. The theoretical elements of the educational plan should deal with concepts such as how learning happens, what the teacher's role is in promoting learning, which activities should be student-initiated, what should be studied, what skills should be developed, what aspects of character are valued, and which environments are best. The relationship of the community to the school should also be considered. There is a broad range of issues that should be explored and that will affect the specific program(s) developed.

The planners should attempt to define the quality of

the educational experience the community will provide for its children, the career and life preparation it considers valuable, and the adult education and community-related programs it wishes to support. The educational plan is concerned with the character and scope of the formal and informal institutionalized learning process. It should outline the practices that will provide desired educational opportunities most completely and efficiently.

The educational plan provides a standard against which existing facilities can be measured, i.e., how well the facilities support the goals defined in the plan. Are the facilities designed for the activities they will house? To what extent have the activities and participants changed in recent years? It also is a source of invaluable information for the planners and designers of new facilities.

In addition to a statement of the educational goals, services and style that the community endorses, the educational plan can include a discussion of the following subplans. The development of each subplan will require input by specialists in the various areas.

1. *The instructional plan* is an outgrowth of the community's general educational philosophy. It discusses what subjects will be included in the curriculum and how course material will be offered on all levels.
2. *The organizational plan* is a system to promote and support the instructional plan. It concentrates on such matters as graded or ungraded organization, team teaching or one-teacher-per-unit formats, maximum/minimum/optimum numbers of pupils per teacher, and organization of subject matter.
3. *The personnel plan* describes the staff required to implement the instructional program. The criteria for selection of teachers and administrators should be outlined as well as guidelines for staff orientation, assignment, retention and dismissal.
4. *The evaluation plan* describes the means of assessing the performance of the school in fulfilling its goals. It should outline what instruments and criteria are to be used in the evaluation process.
5. *The support plan* outlines the resources and services needed by and available to the instructional plan. For example, it details provisions for career guidance, psychological counseling, food services, health programs, transportation, and maintenance.

Because the educational plan is broad in scope,

THE EDUCATIONAL PLAN

Figure 7

formulating it is a complex undertaking, but one that is central to the total planning process. The success of all subsequent planning depends on how accurately and thoroughly the plan has articulated the community's educational philosophy and the ways educational goals will be realized.

Evaluation of Existing Facilities

A facilities master plan must include an examination of existing facilities. The appraisal should concentrate on answering these general questions: (1) In and of itself, is the building adequate? and (2) Does the building effectively accommodate the users and the program?

Specifically, the appraisers should examine the following conditions:

1. Is the facility structurally sound?
2. Is it healthful and safe?
3. Is it efficient to operate?
4. Does it support the program?
5. Is it attractive and comfortable?
6. Is its location convenient for the users?
7. Is its space optimally used?
8. Is it the right size?
9. Can it be modified?
10. To what extent can required activities be accommodated?

Responding to these questions requires knowledge of a broad range of concerns from the technical to the aesthetic. The evaluation should concentrate on spaces for teaching/learning, administration, and support services.

Physical appraisal. Health and safety standards are outlined by local, state and federal building codes; compliance with these codes is ordinarily carefully regulated. Nevertheless, the appraisers should not ignore health and safety aspects of the built environment. Accessibility for the handicapped should also be considered. These are all essential to the operation of a desirable educational program.

The structural soundness of the building should be evaluated in terms of the condition of the foundation, stairs, stairwells, floors, walls, ceiling and roof. Structural adequacy, if questionable, should be checked by a qualified engineer. Generally, schools tend to become educationally obsolete before they become structurally unsound.

Other major physical factors to be evaluated concern the condition and operation of heating, ventilating and air-conditioning (HVAC) systems, and electrical, lighting, water, and sewage systems. Needed repairs and replacements should be noted. Finally, but no less important, the operation and

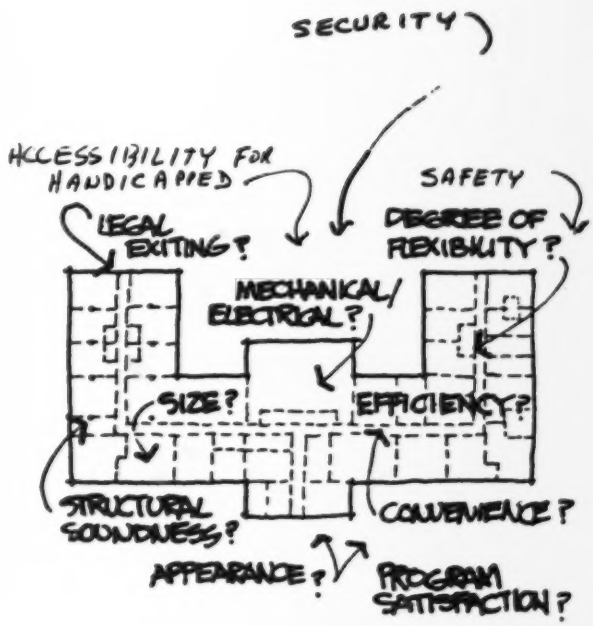
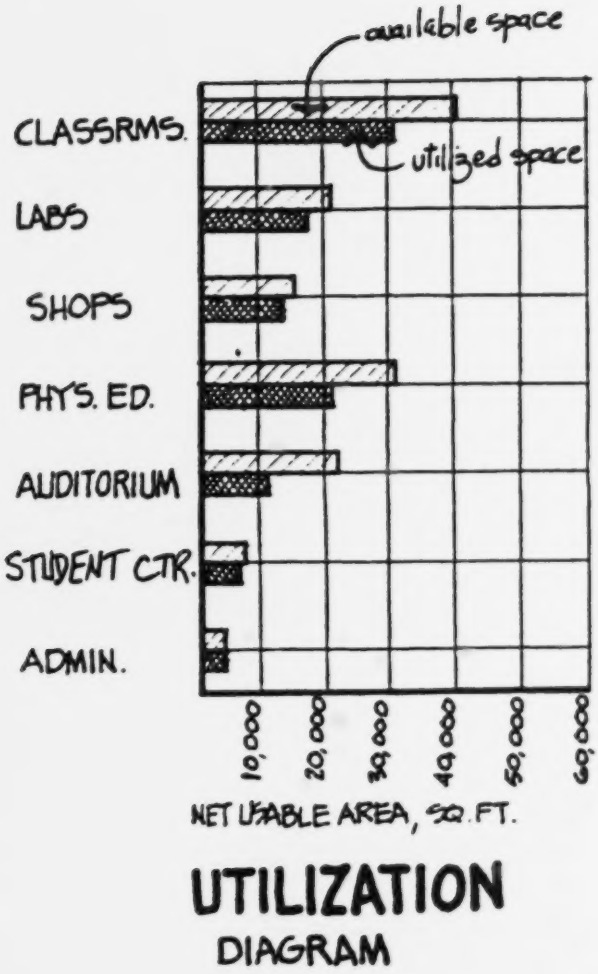


Figure 8



UTILIZATION DIAGRAM

Figure 9

maintenance costs (especially energy costs) should be reviewed. Attention should be paid to the facility's efficient use of energy and whether high energy consumption is due to human wastefulness in operating the plant or to poorly designed structural and environmental systems.

The aesthetic quality of the school building and site should be considered. The school should be visually attractive and well landscaped. In addition it should be comfortable and capable of encouraging full and constructive human use.

Occasionally school buildings have historic value—they may be old or original community structures representative of a unique style. Preservation of such buildings should be considered in the evaluation process.

It is recommended that an architect and an engineer be employed to make the physical appraisal of the school building because of the technical aspects of the appraisal and the potential exposure to legal liability.

Program support appraisal. Perhaps the most crucial aspect of the facilities evaluation is concerned with how well the building supports—or can be economically modified to serve—the educational program. Older buildings should be examined for their adaptability to accommodate teaching/learning situations, techniques, and equipment they were not initially designed to house. Building spaces that were not designed for instructional activity (halls, storage areas, basements) should also be evaluated for potential renovation.

Site appraisal. The location of an educational facility should be evaluated in terms of convenience, safety, proximity to students, and the quality of the neighborhood environment. Detailed spot maps showing where concentrations of students live in relation to the school are helpful. The site should also be appraised in terms of its suitability for the educational program.

Utilization. Utilization of existing facilities primarily involves two issues: (1) Are optimum numbers of people inhabiting a given space? and (2) Is optimum use being made of the space? Determining how well an existing facility is being utilized appears to be a simple process: take the capacity assigned a building and the number of people using it, and figure the percentage of the capacity being used. Determining capacity may be as simple as looking up the capacity assigned to the building by the state education agency when the building plans were approved (although changes over time may have rendered this figure obsolete). Occasionally state education

agencies have formulae for computing capacity.

The utilization of the educational plant may be expressed in terms of room utilization or student station utilization. Room utilization is usually expressed as the percentage relationship between the number of periods per day that rooms are used and the total number of periods all rooms are available for use. Similarly, student station utilization is expressed as a percentage relationship between the number of student stations used and the total number of student stations available for use.

Utilization should not be judged solely in terms of the number of pupils per square feet of area or the frequency of room use. The overall educational program, department programs, and specific courses should be examined to determine **what** is being done in the school and, perhaps more important, **how** it is being done.

It should also be noted that capacity may be reduced as the quality or scope of the educational program is improved.

School size. The size of an educational facility should comfortably accommodate the inhabitants and support the educational program. Other local factors such as density of population, availability of sites, and transportation capabilities have bearing on school size. There is little reliable research on ideal school size. Quite probably a thorough search into the literature would yield almost any number between 100 and 6,000 as having been proposed by someone as the minimum, maximum or ideal student body size. At one time there was fairly general acceptance of the idea that there is a positive relationship between bigness and educational quality. However, it has been observed that there is no virtue in size alone. In cities, large schools are common, mostly by reason of economy and high land costs. In such cases, the negative effects of size on the quality of human relationships must be dealt with.

Evaluation instruments. Many tools have been developed for the evaluation or rating of school buildings. An examination of some of these (Sumption and Landes, 1957; Reida, 1962; New Jersey State Dept. of Education, 1976; Keck, 1978; and "War on Costs," 1982) reveals more similarities than differences. They often vary in the order in which major areas for evaluation are arranged, the approach or emphasis used, whether a point system is additive or subtractive, or whether a numerical score-keeping procedure is used at all. Such instruments can be valuable tools for data collection or as check lists in the total evaluation process, but their limitations should be recognized and the results should

Lay citizens are frequently confused and dismayed to discover that the old high school that formerly housed 2,000 students is now badly overcrowded with 1,500 pupils. They fail to recognize that the necessary expansion of the library, guidance facilities, science laboratories, along with the installation of small group seminar rooms, language laboratories, and other needed improvements has drastically reduced the capacity of the building. This continuing reduction of capacity represents an attempt to modify obsolete structures to accommodate modern educational programs. Capacity, therefore, is a dynamic figure and one that should continue to decline in the years ahead.

— *Donald J. Leu,*
PLANNING EDUCATIONAL FACILITIES.
New York: The Center for Applied Research in Education, Inc., 1965.

Figure 10

If one accepts the premise that a school plant performs a service function for the educational program, then the adequacy of the plant should be judged in terms of the quality of service it will render over its useful life span. This suggests that both technical and educational functions must be considered.

— *Carroll W. McGuffey*
MEEB: MODEL FOR THE EVALUATION OF EDUCATIONAL BUILDINGS
Chicago: Simu-School, 1974.

Figure 11

be interpreted by experienced and well-trained persons.

MEEB, an evaluation instrument developed by McGuffey in 1974 (published by Project Simu-School), takes a systems approach. The use of this instrument requires the involvement of a professional planner who can assist in the development of evaluation criteria.

Developing The Facilities Master Plan

The facilities master plan is an illustrated document that describes existing and future buildings, site topography, building orientation, climate, vehicular and pedestrian circulation, location of utilities, energy resources and consumption, site development, financial capability, and neighboring land use (both current and projected).

Master planning is a way of identifying the best route to the future through a workable plan for handling priority-rated, predictable situations and anticipated changes. A master plan defines ultimate goals and the facilities required to help achieve the goals. The capacities and capabilities thus defined are realized, if necessary, through several phases of construction and expansion or reduction and modification. These activities are viewed in terms of their relationship to the total program.

Assessment of energy resources. The development of the facilities master plan cannot be completed until energy has been considered. The level of energy use, an energy utilization index and an energy budget are important features of the plan. Steps should also be taken to examine the continuing availability of energy resources that will be required to operate the building indefinitely.

Assessment of financial resources. If the facilities master plan reveals a need for facility improvements or new construction, cost estimates are made. For most school districts, the amount of money that can be spent on construction or modification is determined by legal considerations, by the real or supposed willingness of citizens to provide funds, by the availability of state or provincial monies, or by a combination of methods. Therefore, the fiscal affairs of the school administrative unit must be thoroughly analyzed. When all alternative methods of financing are evaluated and careful long-range financial planning is accomplished, savings of large sums of money often result.

Several funding sources for educational facilities are listed below. More detailed discussions appear in Units K and L.

Funding sources. Historically, local funds have been the primary revenue source for school construction. These funds are ordinarily derived from local property tax levies, although gifts, bequests, insurance settlements, and sales of school district property are minor local sources that may be available.

Local property tax receipts might be earmarked for construction of school facilities on a cash basis, but this financing method is usually not feasible unless the tax base is exceptionally large and/or the needed improvements are relatively inexpensive.

Some states permit local school districts to levy taxes for accumulation of funds for future school building needs. Funds are collected, invested in interest-bearing securities, and accumulated until sufficient amounts have accrued.

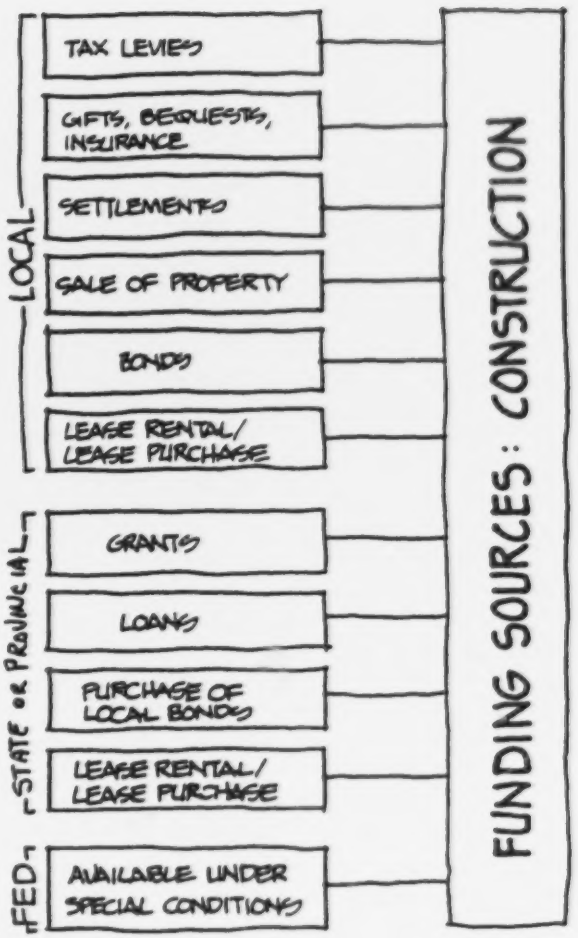
Local school districts usually have the capacity to issue bonds for school building purposes. Often statutory or constitutional requirements limit the amount of bonds that may be issued, the interest rate that may be paid, or the length of term of the issue.

Some states permit lease-rental or lease-purchase arrangements for school facilities with public or private financing authorities. This type of financing is usually allowed when legal debt limitations are unrealistic; it often costs more in interest payments than do direct debts of the school district.

In recent years many states have expanded their participation in financing school facilities. This participation has taken many forms, including grants of funds for construction or for debt service, loans from revolving funds, combination loan-grants, state purchase of local school bonds, and creation of state authorities for lease-rental or lease-purchase arrangements.

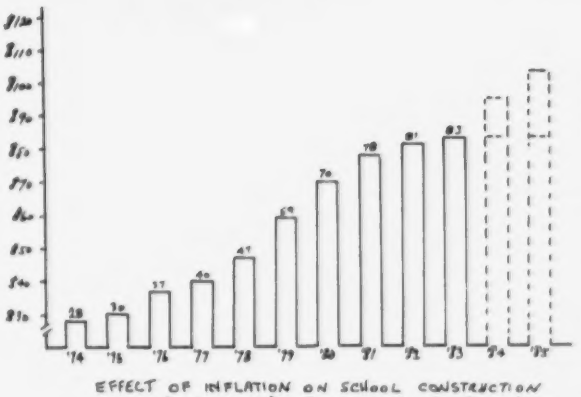
Federal funds for construction purposes have been negligible except for those districts burdened by erosion of the local tax base or by enrollment increases from federal installations in or near the school district. Federal monies are available for equipment under certain conditions.

Estimating construction costs. Accurate long-range forecasts of construction costs are difficult to develop. Price trends of materials and labor are almost impossible to predict accurately. Therefore, specific long-range estimates are best avoided unless demanded by school officials. When cost estimates are given for a five to ten year period, school officials should be aware of the questionable validity of the estimates and should attempt to have them updated periodically.



FUNDING SOURCES: CONSTRUCTION

Figure 12



EFFECT OF INFLATION ON SCHOOL CONSTRUCTION COSTS (PER SQ. FT.)-- Source Alberta Education

Figure 13

C-15

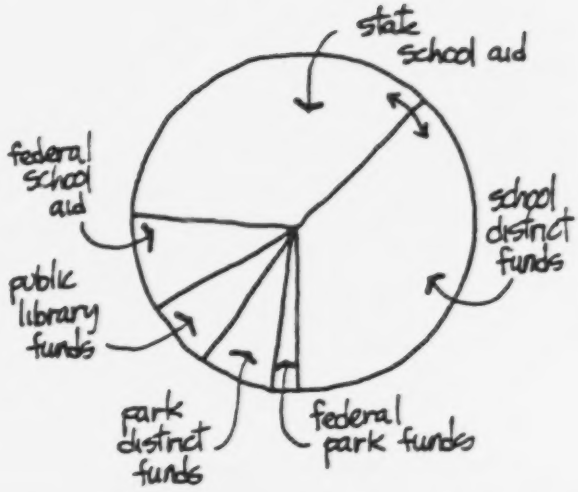


Figure 14

Analyzing capability for funding construction. All potential funding sources — and combinations thereof — should be considered. If construction funds come largely from property taxes, historical trends of assessed valuation should be studied and a projection for the future should be developed that will be updated annually. Outstanding school district debts should be analyzed for the possibility of dovetailing payments with potential future debt service requirements to obtain equal annual payments and possibly stable tax rates. Projected expenditures for staff, operation and transportation should not be ignored.

Cooperation with municipalities and county governments in financing planning is often overlooked. Possibilities exist for joint school-civic government action with respect to site acquisition, use of certain facilities, and urban renewal programs on both new projects and major alterations. Some states, however, have laws restricting full joint use of facilities.

The history of the community's willingness to support public education should be studied. Barriers and non-supportive groups should be identified and analyzed. Public involvement in planning and public relations programs should be instituted. Comprehensive facilities surveys that have involved citizens have proved successful in gaining public support for school construction projects.

Recommendations. The recommendations section of the facilities master plan should document the need for additional sites, abandonment of existing facilities, new construction, modernization, renovation or change in use.

Recommendations should address both short- and long-range needs and situations. Recommendations that address immediate needs should also facilitate the attainment of long-range objectives. The development of recommendations involves reviewing pertinent facts, considerations, and alternative solutions, and using good judgment in making final decisions.

Reconciliation between educational facility needs and financial resources usually is made in the recommendations development stage. Occasionally elements of the plan must be postponed until funds are available. However, a general plan for financing the improvements of each phase should be developed and a specific financing plan prepared for immediate projects.

Interpretation Of The Plan

The Board of Education, which was responsible for seeking the facilities master plan, will present it to

the community and act upon its recommendations. Since implementation of any major building program is usually contingent upon public understanding and support, the community must be fully informed of the identified needs, of plans to meet the needs, and how and why the plans were adopted.

Although many citizens do not wish to read an entire report, they are often interested in the major findings, conclusions and recommendations. Development and distribution of a capsule report of the plan is an important public information technique.

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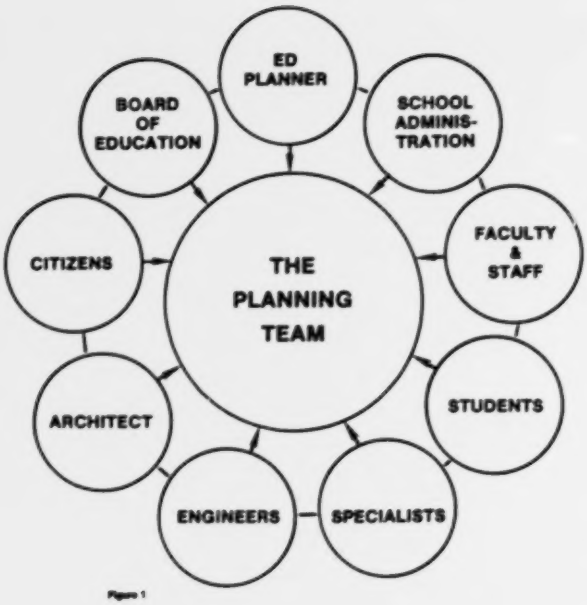
D

THE PLANNING PROFESSIONALS



The planning and construction of educational facilities are processes requiring cooperation among a large number of planning team participants. The team includes individuals who specialize in planning and, more recently, individuals who are education specialists. Teachers, administrators and students bring to the planning team an understanding of educational requirements. This unit is reserved for the other members of the team, the planning professionals. The planning professionals are the facility managers and designers who translate educational needs into a facilities solution.

The planning process requires that participants develop a relationship based on mutual confidence and respect. To do so, it is important that the planning team understand the various roles and responsibilities of the planning professionals. The owner should know how to select a consultant and also understand how the planning professionals typically address the tasks before them.

An increasing number of educational institutions employ professional planning specialists who work closely with outside consultants, the other major source of planning professionals. While the method of selection obviously differs for these two groups, the services offered are the same.

Although all participants of the planning team are important to the planning process, their levels of involvement shift in response to the need for their services during the various stages of project development. Principal areas of expertise needed for most projects would include educational planners, architects, mechanical, electrical, structural and civil engineers. Involvement by a secondary group, for example, acousticians, color and decorating specialists, energy managers or cost consultants, is equally important to the progress of a project, but their involvement is less sustained. Successful project administration is needed to get these people involved when their specialization is required.

The Educational Planner

The educational planner serves the planning team as a catalyst and, at times, a referee. This person interprets and evaluates the educational objectives outlined by the owner in terms of educational performance and design and is most often a member of the owner's staff.

Unlike many of the other planning professionals, the educational planner's path to the profession is less clearly defined by an academic background. Few programs of study are directly associated with preparing educational planners. As a result, their backgrounds are diverse and include such fields as

architecture, educational administration, engineering or business administration. Each of these fields of study prepares the individual to develop expertise in solving problems relating to educational facilities.

Institutions often employ planners but also ask them to perform other administrative or teaching services. Large systems enjoy the luxury of employing an individual with singular responsibilities of planning, but small systems often require the planner to assume additional roles as primary administrator, purchasing agent, business officer, physical plant director or academic officer.

The Architect

The architect is the professional who, with the help of the planning team, is responsible for translating the educational requirements into a well-designed facility. The architect, in most cases, will have completed a minimum of eight years of study and in-service training and, in addition, will have passed comprehensive examinations in which qualifications to practice architecture must be demonstrated. The architect may be a member of a national organization that requires compliance with a code of ethical professional practice. Because they are licensed to practice architecture in each state/province, they may hold multi-registrations.

Architects are employed either by an educational institution as staff members or as outside consultants. Architectural consulting firms range in size from a single architect to a very large organization employing hundreds of architects, engineers and support staff.

Engineers

Structural, mechanical, electrical and civil engineering are specializations comprising another group of planning professionals. Their roles in the planning process align closely with the work of architects because much of the detail associated with a facility is provided by engineers. They have prepared for their professional positions by completing specialized programs of study and passing comprehensive examinations before they may practice.

Engineers are typically outside consultants, but large educational systems may employ staff engineers. Engineering consulting firms and architectural firms with engineering divisions are the principal employers of these specialists.

Other Specialists

The number of professionals in this category is large. They represent areas such as:

Financial Analysis
Transportation and Parking
Interior Design and Equipment
Energy Management
Acoustics
Security
Maintenance

When specialists are not available to represent the owner, they are employed through consulting firms. The number and type of specialist involved with a project are functions of the need for services and the stage of the project developed.

Roles And Responsibilities

The educational planner. There are six principal activities in the planning process involving major input from educational planners:

Master Plan/Capital Program
Educational Specifications/Building Program
Project Coordination
Facility Management
Orientation
Postoccupancy Evaluation

1. *Master Plan/Capital Program*

An important role for the educational planner is the development and implementation of a long-range facility plan designed to respond to educational requirements of the system. Emerging technology, changing enrollments and limited resources have forced educators to look forward and build strategies to meet future demands. Planners collect, analyze and summarize the plethora of information about institutional philosophy, programs and personnel in order to develop a master plan that begins to answer questions about future facility needs. As coordinator, the planner draws upon the talents of other institutional specialists to assist in the development, review and implementation of the master plan.

The planner is responsible for development of a capital plan. The capital plan is a short-range list of projects needed to meet the master plan. Projects are ranked and worked through the funding mechanisms based on this carefully orchestrated plan. Each project is checked for consistent adherence to the master plan to fulfill an institutional objective. Its position on the capital plan shows its relative priority to other institutional needs.

2. *Educational Specifications/Building Program*

A project is placed on the capital program because the need for the facility is well documented and recognized. The educational planner's next responsibility is to coordinate the development of educa-

PRINCIPAL ACTIVITIES OF THE EDUCATIONAL PLANNER

+ **Master/Plan/Capital Program**
+ **Ed. Specifications/Building Program**
+ **Project Coordination**
+ **Facility Management**
+ **Orientation**
+ **Post Occupancy Evaluation**

Figure 2

tional specifications/building program with the help of other owner representatives and the planning team participants. The building program is a comprehensive statement of the problem to be addressed by the planning team as the project develops. For a more detailed discussion of program planning and educational specifications, see Units C and E.

Project architect/engineer involvement in this early stage of the planning is sometimes a part of their services but most often is not. The building program is often used as the information base for the selection of consultants. The planner then is responsible for the interpretation of this document.

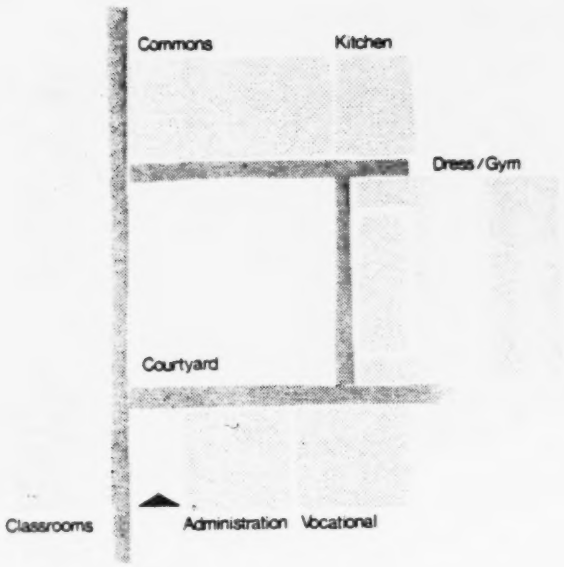
3. *Project Coordination*
Educational planners are usually the only planning team participants that stay closely associated with a project from the time it appears in the capital program through occupancy. They are also the primary liaison with the owner in reporting progress of the team. As project coordinator, the planner is in a unique position to keep both the planning team and the owner informed of activities.

4. *Facility Management*
The initial occupant in a completed facility has anticipated using the facility for a long time and will probably fully utilize the space. But with changing enrollments, programs and personnel, the planner's role as facility manager becomes more important. By the reallocation and scheduling of facilities, opportunities are provided to maximize the use of limited resources and occasionally reduce the need for additional facilities.

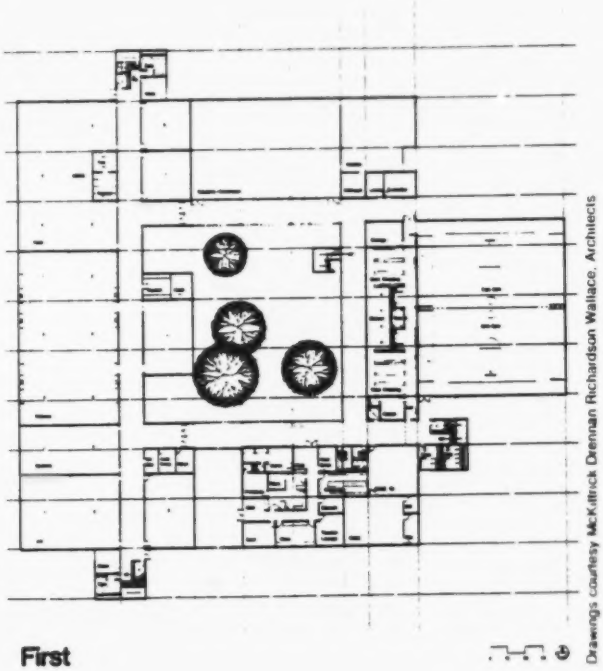
5. *Orientation*
The educational planner, in association with the other planning team participants, must orient students, teaching staff, administrators and the public to the new, modified or renovated facility. Although many of these people have followed the progress of the project, an orientation allows the users to learn about their facility from the designers. The orientation is also useful to the planning team because of the first impression comments from the users.

6. *Postoccupancy Evaluation*
A postoccupancy evaluation, approximately one year following initial occupancy, presents the planner with an opportunity to hear from the users about the good and not-so-good features of the facility. Those features that deserve attention may then be considered for correction. The good features may be passed on to the next project because of their demonstrated success.

The architect and engineer. The services of the



First Floor Plan



Drawings courtesy McKittrick Drennan Richardson Wallace, Architects

First

architect and engineer often begin before the actual design is started and will continue until the facility is complete and accepted by the owner. To make the design process work most effectively, the architect/engineer and the rest of the planning team must establish and maintain well-defined lines of communication, responsibility and authority. There are six major phases or areas of service involved in the planning process:

Predesign Planning
Schematic Design
Design Development
Construction Document Preparation
Bidding
Construction

1. *Predesign Planning*

The most important predesign activity is the preparation of educational specifications or a building program. The preparation of a comprehensive program is essential to the success of the entire project. For a detailed discussion of educational specifications, see Units C and E.

The architect and engineer should participate in the development of the building program as advisors on the architectural possibilities and limitations. Whatever the level of involvement, participant or observer, knowledge of facility needs and anticipated use will be expanded by the architect and engineers in attendance at preplanning sessions. It is also desirable for them to be included in discussions leading to site selection if possible. It is important to note that the predesign services by the architect and engineer may be classified as additional services in a standard agreement.

2. *Schematic Design*

During the schematic design phase, the architect and engineer, with the help of the owner's educational planner, will translate the written program into graphic representation. The process will start with a series of work sessions to discuss and analyze the building program. The initial concern is with conceptual organization, functional relationships and circulatory patterns in response to the program. The site is soon introduced into the planning process, and the physical concepts of land use begin to emerge. Site size, configurations, topography, climate, availability of utilities, and relationship to the community are factors that influence the order and scale of the physical dimension. For example, a small urban site could result in a multistory concept to be developed, whereas a large rural site would allow a lower profile concept for the same program.

Each architect employs a unique process in developing a schematic design. Some work in a two-dimensional framework (land use diagrams, floor plans) and others in three dimensions (spatial studies, models and sections). In either case, early dialogue with structural, mechanical, electrical and civil engineers is necessary to determine concept feasibility and potential system application, cost and availability of materials and systems, and performance expectations as related to building program requirements. Applicable codes and laws must be reviewed and their requirements adhered to in the schematic design. For example, in most building codes there is a maximum allowable area per floor based on occupancy and type of construction.

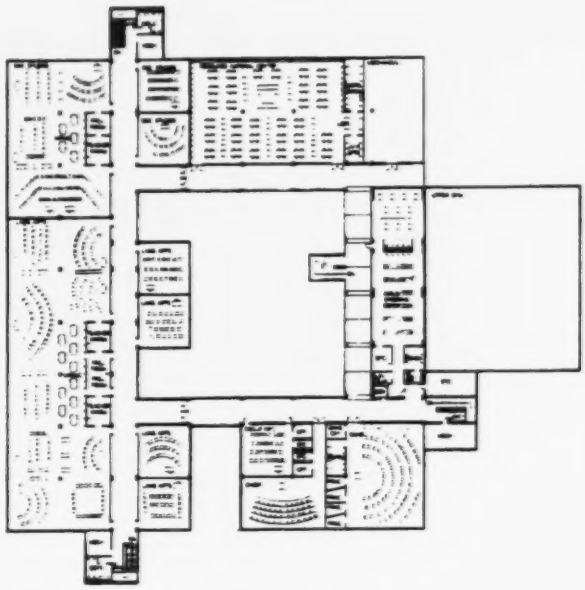
The architectural team will synthesize all program, site, design and engineering factors into one or more schematic designs to be presented to the owner and the educational planner for review, along with an outline specification. Each design should be analyzed and discussed with regard to functional validity, conceptual organization, environmental/aesthetic qualities, and related estimates of cost.

At this point either one schematic design or a combination of several will be singled out for further development. In the event that none of the designs satisfy the planning requisites entirely, either the architect must try something new or priorities must be re-evaluated. For example, if the size exceeds program requirements or the complexity of the program requires a facility more expansive than the budget will allow, something has to give — either quantity, quality or cost. On a large, complex project it is not uncommon to go through this action/reaction process several times before a workable solution is reached.

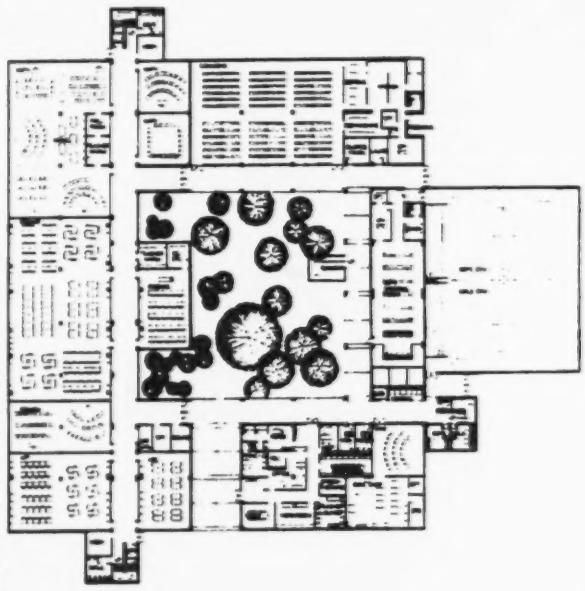
Changes, variations and different arrangements may be tried at this time with relative ease. It is essential that a real dialogue exist between architect, engineer, planner and owner during this period to assure everyone that the final solution is the best that the team can achieve. When the schematic design is agreeable to members of the planning team, it goes to the proper authorities for review and approval.

3. *Design Development*

With the schematic design approved, the architect and engineer proceed to develop it into its final state. Plans are studied at larger scales and three-dimensional relationships are developed. Elevations, sections, perspectives and models are prepared to exhibit such visual aspects as form, functional expression, scale, image and intrinsic atmosphere. Circulation systems, room configura-



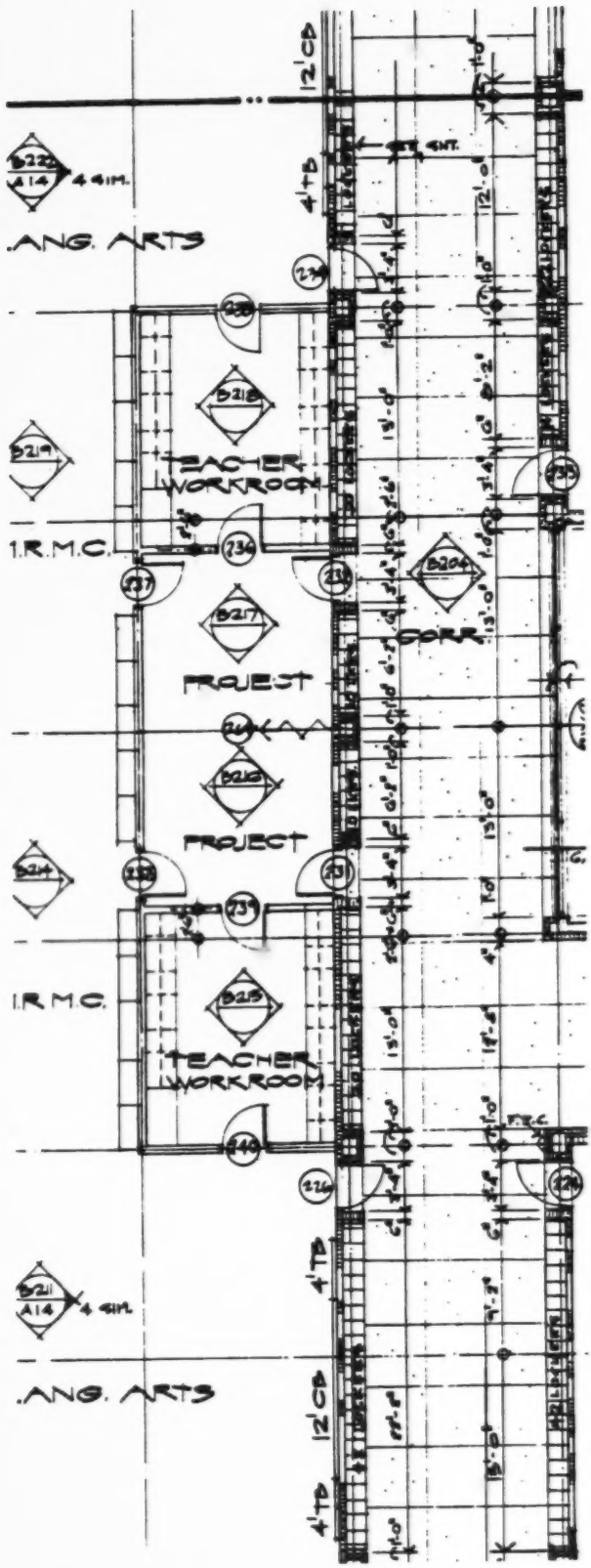
Second Floor Plan



First Floor Plan

Drawings courtesy McKittrick Drennan Richardson Wallace, Architects

D-7



Drawings courtesy McKittrick Drennan Richardson Wallace, Architects

tions and layouts, use of materials, and design of interior and exterior wall systems are developed and finalized. At the same time, engineering systems are being developed and there is continual communication between architect and engineer.

The structural engineer has by now an approved structural system and must establish the location and general sizes of all structural members. The calculations of the structural engineer respond to soil conditions, seismic requirements and loading factors (governed by codes). In addition, aesthetics, building techniques and availability of materials must be considered.

The mechanical engineer responds to climatic factors (winter/summer temperatures, solar factors, etc.) in relationship to the percentage, location and type of exterior glazing called for in the design to determine heating and cooling loads. The educational program requirements are a major consideration because the size of a room and the activity within it directly affect those loads.

The electrical engineer must locate and adequately size electrical power to the project. Distribution systems are designed to bring power to spaces in response to the need for lighting and equipment. They are also responsible for wiring systems to accommodate telecommunication and computer network equipment.

The civil engineer works with the architect to help locate the building on the site and consequently develops site grading, paving plans, roadways and connections to utilities.

At the completion of design development, current and detailed cost estimates are prepared for review and approved by governmental agencies. The plans are also submitted to the owner and the governing authority for review and approval.

4. *Construction Document Preparation*

From the approved design documents, the architectural/engineering team proposes complete working drawings and construction specifications for the project. In broad terms, the working drawings establish quantity — sizes, shapes, locations and relationships; the construction specifications establish quality — standards, types, manufacturers and suppliers.

More specifically, the working drawings are divided into sections according to disciplines: civil, architectural, structural, HVAC (heating, ventilation and air conditioning), electrical, plumbing, fire protection.

The architectural section includes: plans with

detailed dimensions locating all walls, partitions, openings, shafts, stairs, toilets, etc.; sections showing location and interrelation of materials; reflected ceiling plans showing lighting, mechanical distribution and ceiling types; elevations indicating size and location of windows, doors and material usage; and details that amplify and clarify conditions as required.

The engineering sections contain floor plans with each system graphically represented by overlays. Close coordination is needed at this point to resolve any inconsistencies or contradictions. For example, the mechanical engineer must furnish the weights of selected equipment to the structural engineer and their power requirements to the electrical engineer for inclusion into their calculations. Any effect on other sections must be resolved and incorporated into the drawings.

The specifications are developed concurrently with the working drawing package. Typically, they are divided into three parts:

Bid Documents
Conditions of Contract
Technical Division

The *Bid Documents* section includes addenda (changes in drawings or specifications issued before the contract is awarded), advertisement for bids, instruction to bidders, proposal, contract, and required performance and payment bond. Equal opportunity and affirmative action reporting procedures are also a part of this section.

The *Conditions of Contract* section is divided into two parts, general and specific. Included in the general conditions are such items as ownership of drawings, architect/engineer's authority, payment of taxes, inspection of work, changes, delays and termination of the contract. The specific conditions apply only to the project under contract. Included are both contractor's and owner's insurance requirements, time for performance and the schedule of working drawings.

The *Technical Division* describes the quality of materials and systems, construction methods, and installation procedures for the project. This material is usually organized into 16 divisions. One provides general data for construction, such as use of samples and responsibility for shop drawings, required construction practices, and extent of temporary on-site facilities. The remaining sections are divided by construction trades.

A specification may be written in two different ways, depending on the situation. A performance specification (describing the product itself) is used when

more than a minimum performance is desired. It is a good idea for the owner and the educational planner to be involved in the development of the specification, because it establishes the relationship between quality and economy, balancing cost with budget. Because it is a part of the contract between owner and contractor, the specification includes standards of quality that are legally binding. Communication between all parties involved will help limit the number of costly, time-consuming changes during the construction process.

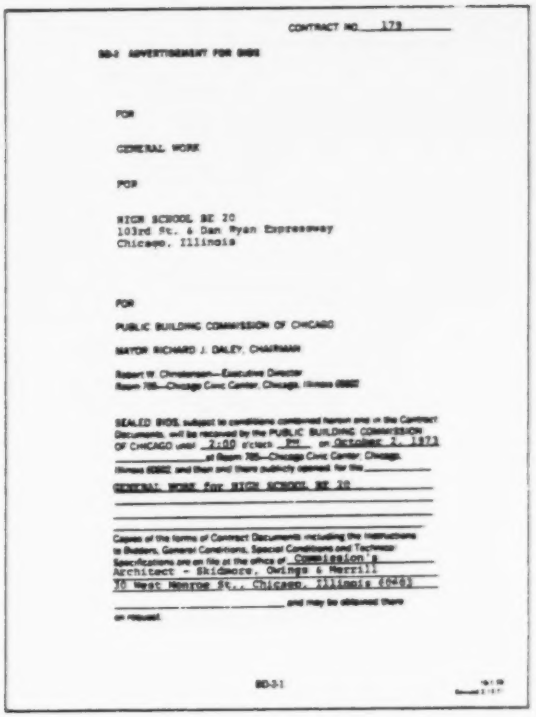
At this time the architect and engineers review and update the earlier cost estimate. The owner is notified of any cost changes that have resulted from changes in project requirements or market conditions. In the event the new cost estimate exceeds a fixed budget, there is very little that may be done except to reduce the cost of the work by reducing either the scope of the project, the choice of materials or both. The completed construction documents go to the appropriate governing authority for approval and authorization to receive bids for the project.

5. *Bidding/Tendering*

During this phase, the architect and engineers assist the owner in obtaining bids and awarding contracts. Together they determine how the project is to be bid and what contractors are qualified to bid, although with public work, these questions are generally established by law. Prequalification of contractors planning to bid the project is often desirable and, in many areas, required by law. The owner and the architect should be familiar with these requirements. They prepare the advertisement for bids, have it published, and establish a date for receiving bids. The designers issue construction documents to all qualified bidders, answer questions, and clarify any aspect of the construction documents. Together the owner, architect and engineers evaluate the bids received and determine to whom they will award the contracts. It is generally a requirement that the owner award the contract for construction of public work to the lowest *qualified* bidder. Legal counsel should review and approve any contract documents prior to execution and award to the successful bidder.

6. *Construction*

The months of discussion, analysis and planning are over. A meeting typically is called for the architect, educational planner, engineers, owner representatives and contractor to discuss the project. The contractor outlines his operating procedures and the owner points out any particular problems or policies affecting the work. The scene



CONTRACT NO. 179

BID ADVERTISEMENT FOR BIDS

FOR

GENERAL WORK

FOR

HIGH SCHOOL RE 20
103rd St. & Dan Ryan Expressway
Chicago, Illinois

FOR

PUBLIC BUILDING COMMISSION OF CHICAGO

MAYOR RICHARD J. DALEY, CHAIRMAN

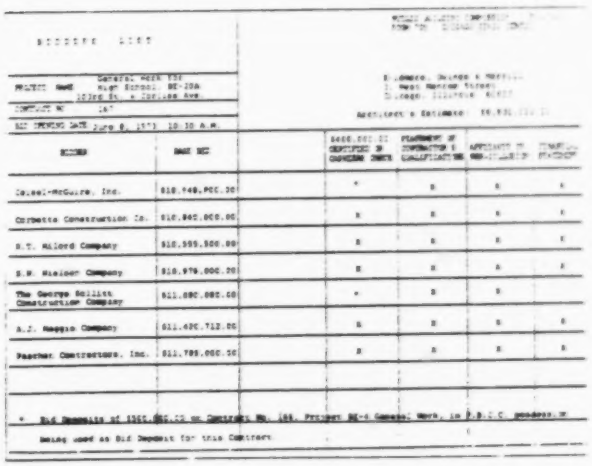
Robert W. Christensen—Executive Director
Room 706—Chicago Civic Center, Chicago, Illinois 60602

SEALED BIDS, subject to conditions contained herein and in the Contract Documents, will be received by the PUBLIC BUILDING COMMISSION OF CHICAGO until 2:00 o'clock PM on October 2, 1973 at Room 706—Chicago Civic Center, Chicago, Illinois 60602, and then and there publicly opened, for the

GENERAL WORK for HIGH SCHOOL RE 20

Copies of the forms of Contract Documents including the Instructions to Bidders, General Conditions, Special Conditions and Technical Specifications are on file at the office of Commission &
Architect - Skidmore, Owings & Merrill
30 West Monroe St., Chicago, Illinois 60603
and may be obtained there
on request.

BID-31



BIDDERS LIST

PROJECT: GENERAL WORK
High School RE-20A
103rd St. & Dan Ryan Exp.

CONTRACT NO. 187

BID OPENING DATE: June 6, 1973 10:30 A.M.

BIDDER	BASE BID					
Colosi-McGuire, Inc.	$10,948,900.00	*	X	X	X	
Corbetta Construction Co.	$10,960,000.00	X	X	X	X	
H.T. Hilard Company	$10,999,500.00	X	X	X	X	
E.W. Wilson Company	$10,979,000.00	X	X	X	X	
The George Sollitt Construction Company	$11,080,000.00	*	X	X		
A.J. Maggio Company	$11,490,712.00	X	X	X	X	
Fischer Contractors, Inc.	$11,799,000.00	X	X	X	X	

* Bid Deposits of $365,00 on Contract No. 181, Project RE-1 Canaan, Work, in D.B.I.C. pendency of being used as Bid Deposit for this Contract.

Documents courtesy Skidmore Owings & Merrill Architects

is set to start construction.

The architect and engineers perform a variety of activities during the construction phase of the program. They issue bulletins and orders to accomplish changes requested by the owner or required by field conditions. They review detailed drawings prepared by the contractor and his suppliers to demonstrate compliance with the documents. These drawings are referred to as "shop drawings."

The architect and engineers become impartial interpreters of the contract documents, a role that is not always easily understood by the owner. They make periodic visits to the site to monitor the progress and quality of the work and to determine generally if the work is proceeding according to plan. Based on applications for payment submitted by the contractor, the architect and engineers issue certificates of payment to the owner. These certify that, to the best of their knowledge, the quality of work meets the contract requirements and has progressed to the point indicated. They may reject work that fails to meet the requirements.

As the project nears completion, the architect and engineers receive from the contractor and deliver to the owner all required bonds, guarantees, "as built drawings" and related documents. They establish the date for final inspection. When the project is complete and the final certificates for payment are issued, the basic services of the architect and engineer are finished. They often are available to offer advice on facility problems that may arise.

Additional services. The services of the architect and engineer, outlined above, from schematic design through construction, are generally referred to as basic services. They are normally rendered under the agreed fee arrangement. The consultation, or predesign planning phase, may or may not be part of the basic services depending on the project and the degree of participation required.

Additional services may be required by a specific project or requested by the owner. These services require prior authorization from the owner; the architect or engineer is paid for them in addition to the basic fee. Some of these services are:

- Life Cycle Cost Analysis and/or Energy Audits
- Environmental Assessment Checklists or Impact Statements
- Additional Drawings, Specifications or Other Documents to Accomplish Changes
- Detailed Estimates of Construction Costs
- Consultation and Professional Services Concerning Replacement of Work Damaged by

Fire or Other Causes During Construction
Interior Design or Furniture/Furnishings Selection
Services as an Expert Court Witness

Other specialists. It has been said that more than 10,000 questions need answers in the planning of a family home. A project as complicated as an educational facility must, in turn, raise a million questions. Most of these are answered by the primary participants in the planning team, but the rest are addressed by other specialists who are brought into the project when their help is needed.

The following list of specializations identifies only a few of the individual specialists who may contribute to the planning process.

Security
Health and Safety
Acoustics
Interior Design and Furnishings
Energy Management
Maintenance and Operations
Financial Analysis
Transportation and Parking

Selection Of Planning Professions

In most cases, a number of firms capable of providing competent professional services will be interested in a project. The selection of a consultant will require careful consideration of the candidates and their qualifications. The initial steps an owner should take involve: (1) formulating a clear set of expectations regarding the type, quality and quantity of services anticipated (this will allow candidates to evaluate their interest in the project) and (2) developing a list of criteria for use in selecting a consultant.

The initial step of formulating a clear set of expectations requires the owner to make some preliminary decisions prior to interviewing interested architects and engineers. The scope of both the project and the services needs to be explained by answering questions like the following:

- Is the project an elementary, secondary or post secondary facility?
- What is the size?
- What is the budget and what does it include?
- What services are expected of the architect and engineer?
- What services will be provided by the owner's staff?

Methods of selection. The four standard processes for selecting a consultant are:

Design Competition
Direct Appointment
Comparative Selection
Competitive Bidding

1. *Design competition* is time-consuming, expensive and rarely used for selecting an architect for an educational facility. It may be desirable, however, to consider design competition when a grouping of several buildings, such as a college campus or a new university expansion, requires master planning, thus implying a large and complex project scope. If the owner chooses to pursue a design competition, it is important to follow procedures making it fair for all competitors.

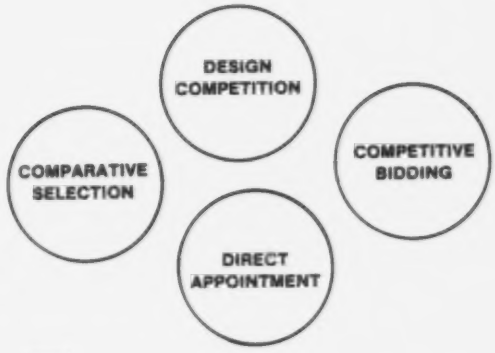
2. *Direct appointment* is the simplest of the processes, although it is also infrequently used outside of private work. It depends on a prior knowledge of the architect's work or strong, reliable recommendation. Direct appointment is, however, a desirable situation for both owner and consultant since known quantities are involved for both parties.

3. *Comparative selection* is the typical method for procuring an architect or engineer for educational facilities. Comparative selection involves choosing from a group of candidates who have submitted to the owner information and materials concerning their qualifications. The process is initiated by the owner making a list of firms who will be requested to submit qualifications.

When an architect or engineer is invited to express interest and submit qualifications, he should be given all pertinent information about the owner and the project. The minimum information to be supplied to prospective consultants includes:

- Name, address and responsible administrative officer representing the owner.
- Description of the project being considered, specifically, number of students, location, area required, and other related information. (The building program is most useful in transmitting this information.)
- Time schedule proposed for the project.
- Brief statement about the involvement of staff members, government officials, community members, students or alumni in the planning process.
- Description of the educational system and its educational philosophy.
- Description of financial resources available for the project, fee structure, and extent of services required.

Providing the architect and engineer with this information serves several functions. It indicates the



owner's attitude toward the planning process; it permits the consultant to evaluate the nature of the project; and it provides the basic information on which they may build responses and present pertinent data during the interview.

Architects and engineers invited to submit their qualifications for consideration should be asked to provide the following information:

- Name, address and type of organization.
- Brief history of the firm, including date established, record of growth in the completion of high quality buildings, type of work, and any specialities.
- Names of principals and key staff who will work on the project, their professional background, registration and affiliations.
- List of projects completed in recent years showing type, size, cost, location and dates.
- List of references, including clients, contractors and financial institutions.
- Statement of philosophy, approach to the design, cost control and construction process.
- Statement of policy in handling of projects, participation of principals, assignment of personnel and engineering services, and other specialized services.
- Copy of the firm's brochure, as well as information about and photographs of completed buildings, and contact person for possible visitation of completed projects by the owner.

4. *Competitive bidding* for professional services is a selection process that has increased in usage because of the desire to assure the public that funds are being used appropriately. Although competitive bidding is a method often used to obtain work and products in other phases of the construction business, it is not an appropriate way to obtain professional services.

A contractor is able to provide a bid price based on clearly defined drawings and specifications, but designers each approach the planning process differently and must consider the undefinable scope of a project long before they should have to.

Interviewing for selection. The selection committee conducting the interviews is usually composed of the owners's planning participants, representatives of the administrative authority and future facility users. This creates a consortium consisting of both seasoned planning professionals and others either with experience in many planning projects or with limited planning experience, but with a particular interest in and familiarity of the project requirements.

The personal interview gives the architect and engineer an opportunity to expand on written statements previously submitted, to introduce key members of the staff who will be involved in the project, and to detail the firm's philosophy and the merits and scope of past projects. It gives the owner an opportunity to clarify any points that may be unclear and to ask specific questions. Most importantly, it provides an opportunity for personal interaction and assessment of potential for a constructive working relationship.

The interview should be held in an atmosphere of genuine interest and mutual respect. Adequate time must be provided in a pleasant setting to permit both parties to respond to one another and for the owner to obtain enough information to support a complete evaluation. It is easier for everyone if the number of firms selected for interviews is limited to four or five.

Criteria for selection. The following points should be considered in the selection of planning professionals:

1. *Registration and Professional Reputation*
Architects and engineers must be licensed by the state/province in which the project is to be built. Many are licensed to practice in several states/provinces.

The planner's standing within the profession is an important basis for evaluation. It is possible to obtain information about professional reputation through conversation with individuals given as references, from articles published in professional journals, and from activity in and honors accorded by professional societies.

It is important to review the qualifications of the individuals actually performing the work on the project. If the project is very complicated and requires special consultants, the qualifications and professional reputation of each consultant should be obtained and reviewed. It may be of particular interest to know the frequency with which the various professionals have worked together on other projects.

2. *Experience*
The owner should consider the planning professional's background in detail. Completed projects similar to the proposed project in type, size or complexity are obvious subjects for evaluation. However, consultants should not be eliminated from consideration merely due to lack of such experiences. They may be well qualified for a particular project and should be allowed to demonstrate the degree of competence exercised in past projects even though these may have been limited in scope.

3. *Staff and Facilities*

The owner should become aware, at least in a general way, of the character of the firm being considered. The quality and experience of the staff should be major concerns. The size of the firm may be a factor in some instances, although efficiency of operation is usually more important. Some firms have become leaders in the area of efficient office procedures using computer-aided design systems and reproduction equipment to reduce their production costs. Often these savings result in lower fees and, more importantly, additional time for owner review of plans.

The size and complexity of completed projects can be helpful indices of organizational ability. Some consideration should be given to the existence of complete architectural, engineering and specialist services in one firm or separate consultants from different firms (either approach may be satisfactory depending on the personnel involved and the adequacy of coordination). The owner may also wish to establish criteria related to a firm's proximity to the site, yet with current means of travel and communication, this may be less critical.

4. *Methods of Operation*

The planning team must achieve a mutual understanding of the project and a smooth working relationship if they hope to complete the project successfully. Therefore, it should be determined that the general operational methods of the consultant will be compatible with those of the owner. The owner should know precisely which member of the firm will supervise the project and whether he/she would continue in that position through project completion.

5. *Interest in the Project*

The consultants should be genuinely interested in the project and should regard it as a challenge to their experience and ability. If work proceeds in an atmosphere of excitement, the total project will benefit.

There are several ways that the owner may determine genuine interest in a project:

- Do consultants contact the owner to ask for detailed information on the project?
- Do they investigate site criteria and interview any of the actual users?
- Do they investigate any long-range goals that the owner may desire?

Interest in a project may be demonstrated by the way consultants answer questions from the owner concerning the firm's ability to take on a project.

6. *Quality of Work*

The owner should establish firm standards of quality expected from a consultant. Too often inferior work has been accepted. Consequently there has been no inducement to perform better. The owner should insist on a professional design that meets program requirements and provides an aesthetically pleasing and satisfying environment for its occupants. Using low maintenance materials and conforming to a budget are not enough. A competent, creative designer who is willing to innovate can develop an excellent educational environment without exceeding the budget or designing a building that will require excessive maintenance in the future.

Conversely, the owner must have a realistic budget for the planning team to work with. Budgets formulated several years in advance must be updated or program scope reduced to reflect projected construction costs at the time of bidding. Construction costs may be obtained with the help of a financial analyst specializing in cost estimates.

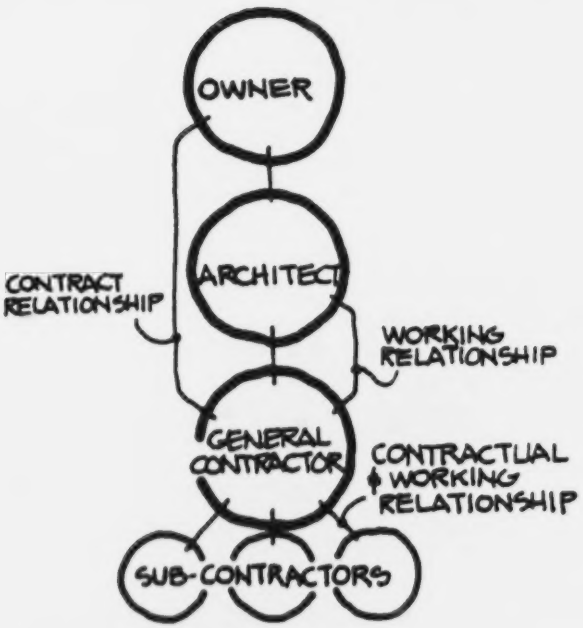
7. *References*

The owner should determine how successfully the architect/engineer has performed for other clients. The quality of past work, its strengths and weaknesses, should be analyzed. A reasonable number of inquiries should be made, including contractors who may have worked with them on other projects.

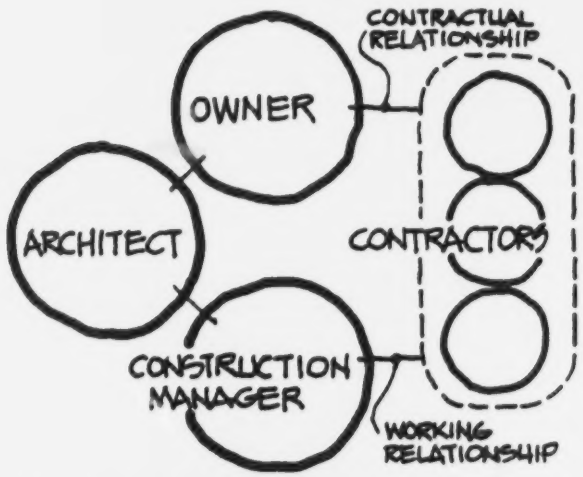
8. *Compensation*

Fees for services vary greatly and should be considered along with other criteria. There are a number of methods from which to choose, and the key issue is "flexibility," since both owner and consultant must feel that the appropriate method of payment has been selected. Some of the methods are as follows:

- If the project is relatively simple and/or the scope of services can be well defined, a *lump sum or cost plus a fixed fee* may be a good option for the basis of compensation. If there is a change in the originally agreed upon scope of services, a renegotiation is required under this method.
- The *multiple of direct personnel expense* (DPE) method compensates consultants for the time that is actually expended for services performed on the project. It is determined by taking the direct costs of the personnel from the firm who are working on the project and applying a predetermined multiplier. This method is especially appropriate for projects or services for which the scope is difficult to



PROJECT ROLES
TRADITIONAL PROCEDURE



PROJECT ROLES
CONSTRUCTION MANAGEMENT

define at the outset or for services where no construction is contemplated.

- A traditional way of compensating consultants has been to base payment on a *percentage of construction costs.* This method may be used if construction is contemplated; however, for services where construction is not contemplated, this method has no basis for compensation and therefore would not be considered.

  If this method is appropriate, it does allow flexibility to vary with building type and size of project. Smaller or more complex buildings require higher percentages, while larger, less complex buildings carry lower percentages. It is a system, however, with some rather serious defects. Owners sometimes suspect consultants of running up costs to earn a higher payment. Consultants feel that they are often penalized for working hard to hold down costs, because lower costs mean lower pay.

  As a result, many consultants and owners are abandoning this system and adopting methods based on lump sum, cost plus a fixed fee, multiple of direct personnel expense, or hourly or per diem, whichever method is most appropriate for the building type or services required.

No matter which method of compensation the owner chooses to use, care should be taken not to cut compensation for services to a minimum. It is extremely important to consider all of the issues related to the selection of a consultant. The selection of the best individual or firm for the project, even if the fee is higher, may prove to be the most cost-effective decision in the long run.

Non-Traditional Roles

This unit has centered around the planning professional's role in what could be considered the traditional planning process. Although the traditional process attempts to integrate the involvement of facility planners in the various phases of planning, rather rigid separations still exist for the predesign, design and construction stages.

New and different roles have emerged in response to the need for more integrated involvement of planners and also to respond more quickly to the planning of facilities. Several of the more notable non-traditional roles are as follows:

Construction management. One of the most successful innovations to the traditional construction method is the phased construction of overlapping stages defined as the construction management

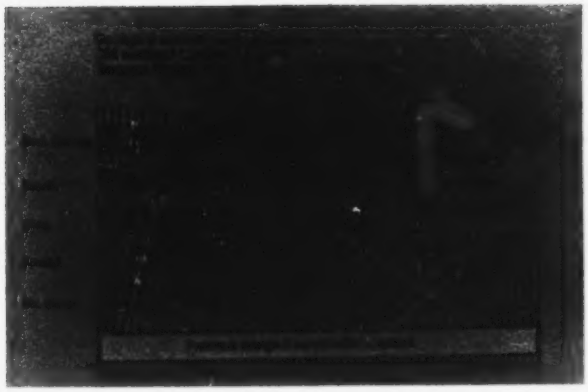
method. During the design phase a construction manager will be hired who will work directly with and be responsible to the owner. The other members of the planning team receive the benefit of guidance from the construction manager in terms of construction experience, knowledge of materials and construction practices. In addition, the construction manager lends experience to the interpretation of the owner's building program. Thus, the entire planning and construction effort is comprehensive, and proper architectural and building techniques and cost constraints are an integral part of the total process.

During the design phase a series of separate bid packages are prepared and implemented simultaneously through several separate construction contracts. The general contractor is eliminated and the construction manager occupies his/her place. The planning and construction team, including the construction manager, continue to monitor the entire project. The usual hierarchical relationship among owner, architect, engineer, contractor, and other planners is eliminated and replaced by a more equal one.

Supporters of construction management are particularly enthusiastic about its efficacy in handling large projects, but because it is a relatively new approach to planning and building, its merits and deficiencies have not yet been fully explored. Nevertheless, construction management is an alternative that the owner of a planned educational facility may wish to consider.

Design-Build. The design-build method is intended to introduce new architectural concepts, new design techniques, and dynamic construction sequences that will simplify and reduce the entire process of programming, design, specifications, bidding and construction. This method differs from the traditional process because the builder is a member of the planning team and is not isolated from the rest of the planning process.

This new design team, including the builder, interprets the needs of the academic programmer; the vision of the spatial and functional design of the architect; the expertise of the engineer; and the builder's experience in materials, costs and construction processes. This design-build team actually programs, conceives, designs, agrees on specifications and constructs the project. The entire process is a dynamic one that only becomes rigidly binding at agreed-upon times and conditions. The overlapping phases simplify the process and give all of the participants an important role in the working relationship of the team.



Fast-Track. The fast-track method of construction differs from the traditional process because of the way various parts of the project are bid, and because work actually begins before the rest of the project design is complete. Footings, foundations and utility extensions are examples of construction work that are fast-tracked.

The impact on the planning team of a fast-track project that creates a non-traditional planning role centers around the need to commit the project very early to a structural system based on the schematic design. Ordinarily the structural system doesn't have to be firm until the completion of construction documents. The planning team is forced to make early decisions and not change them.

Despite the obvious disadvantage of early commitment, the fast-track method does have the advantage of shortening the time required to complete the project. It also allows the early stages of construction to be scheduled to avoid problems sometimes caused by weather.

Lease-Purchase. A lease-purchase arrangement is used occasionally to provide educational facilities where public or private financing funds the construction of a facility. The education system leases the property with the intention of purchasing the property through regular payments to retire the debt. This arrangement is most often used when no other funding possibilities exist.

The educational facility planners' role is different because they are involved with a project where the owner is someone other than the educational authority. The owner (as financier) is interested in providing a facility that is attractive to the potential users, but he is also interested in the investment they have put forth. The planning team must direct their efforts to the project as if it were their own and try to persuade the funding source that the investment is a sound one.

Special Investigations. The last category of non-traditional roles for planners includes a variety of activities they are particularly well suited to undertake but that don't always fall neatly within their planning responsibilities. Several examples of these special services include the following:

- Inventory and evaluation of facilities provide the owner with an understanding of what facilities are available for their use and the relative condition of those facilities.
- Management information systems and computer modeling allow the owner to benefit from integrated data about the educational system's requirements and resources.

- In-service training provided by planners would allow the owner's staff to continue to develop their own facility managers.

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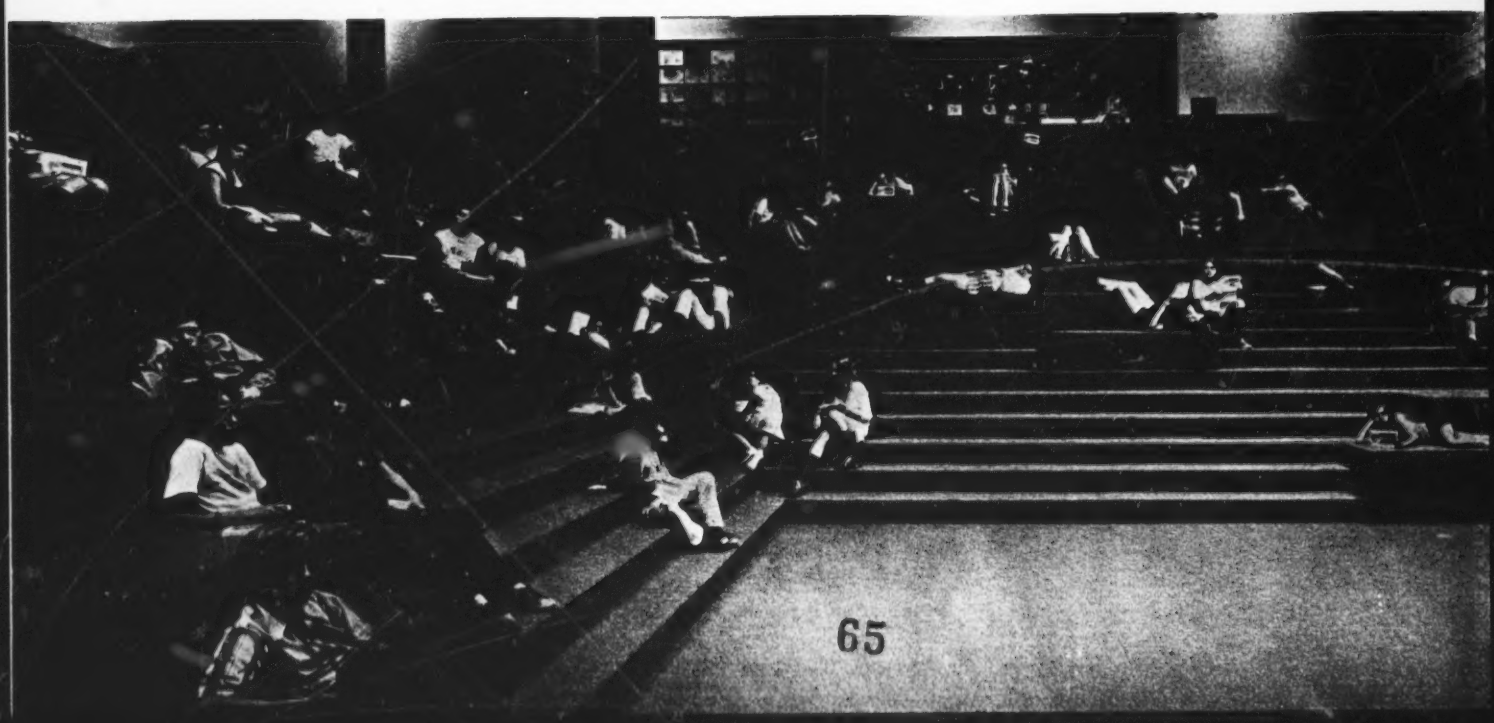
E

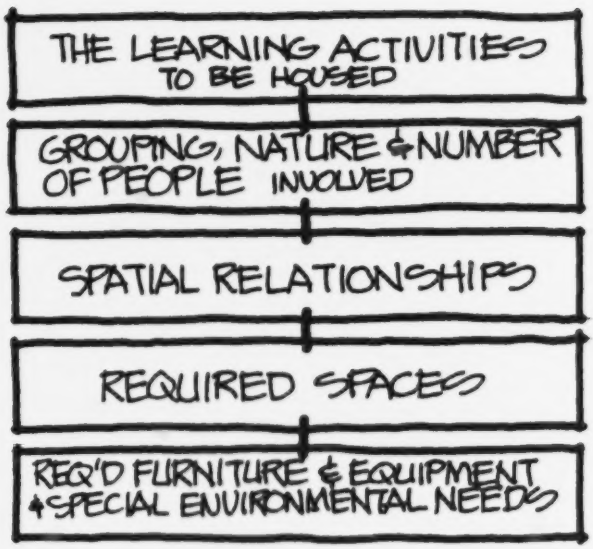
PROGRAM REQUIREMENTS

Tri-Valley Elementary; Perkins & Will Architects.



The construction of a room necessarily depends on the objects to which it is destined and the ends to be obtained; and these must first be considered.

— *Rev. William Woodbridge, ON THE CONSTRUCTION OF SCHOOL-ROOMS, 1831.*


THE LEARNING ACTIVITIES TO BE HOUSED
GROUPING, NATURE & NUMBER OF PEOPLE INVOLVED
SPATIAL RELATIONSHIPS
REQUIRED SPACES
REQ'D FURNITURE & EQUIPMENT & SPECIAL ENVIRONMENTAL NEEDS

EDUCATIONAL SPECIFICATIONS

Program Requirements*

Educational specifications describe the educational activities which a proposed facility must support and the types of spaces which will best accommodate program requirements. They are not a precise delineation of the instructional program; nor are they technical specifications of the type that the architect or engineer directs to the contractor. They are, however, in a temporal and developmental sense, a connecting link between the program and technical statements.

The educational specifications document is a vehicle of communication between the educator and the architect: the educator identifies the educational objectives and suggests general facility needs; the architect bases his facility design on this information.

Characteristics

Educational specifications should describe the learning activities that will be housed in the proposed facility; the number, grouping and nature of the people involved; the spatial relationship between the facility and site; the interrelationships of instructional programs with each other and with non-instructional activities; the major items of furniture and equipment to be used; and any special environmental provisions which would improve the learning environment and promote staff efficiency. Educational specifications should avoid rigid architectural prescriptions, confining its remarks to educational matters listed above. Providing the design solutions is the architect's responsibility. Moreover, the educational specifications document should stimulate creative thinking and, because of its clarity and directness, provoke intelligent communication among educator, consultant and architect.

Developmental Responsibilities

The development of educational specifications is a team, rather than an individual, activity which is accomplished by school administrative unit personnel with or without the assistance of an outside consultant. Usually, the chief school administrator recommends persons for committee appointment. The school board then acts on these recommendations.

The committee chairperson is usually the principal of the proposed facility. If that official has not been identified, then the principal of another administrative unit facility can serve. At any rate, the chairperson coordinates the work of the committee and performs these additional tasks:

- Suggests resource materials and personnel.
- Establishes time schedules.

*This term is used interchangeably with the term "educational specifications."

- Assists in organizing facility visitation schedules.
- Analyzes trends.
- Provides guidance to the committee in organizing materials.
- Reports as a representative of the committee to the chief administrator.

The working committee should be small and selective. It should be balanced in composition, with diversified interests, knowledge, and skills represented. Members should understand their role in relation to both the immediate task and the entire project; they should also understand the necessity for cooperation. Ordinarily members of the teaching staff and others who will be immediately involved in the use of the proposed facility are most able to provide the type of information required in educational specifications. Some important considerations in the selection of committee members are:

- Time available to spend on the project.
- Knowledge about the project.
- Imagination and creativity.
- Ability to work with people.
- Interest in the improvement of the school.

Although enlisting citizen involvement should be a major objective in the broad planning process (their ideas and preferences should have been sought during the Survey development stage), input in this technical area will probably not significantly facilitate the task nor contribute to a better product. To involve community merely in the interests of selling a bond issue or promoting a favorable public image is not an admirable motivation.

The various agents involved in the development of educational specifications and their respective responsibilities are capsulized below:

Board of Education

- Adopts permissive and guiding policies.
- Appoints working committee.
- Approves the official and written product.
- Authorizes the services of consultants.
- Employs the specialists.

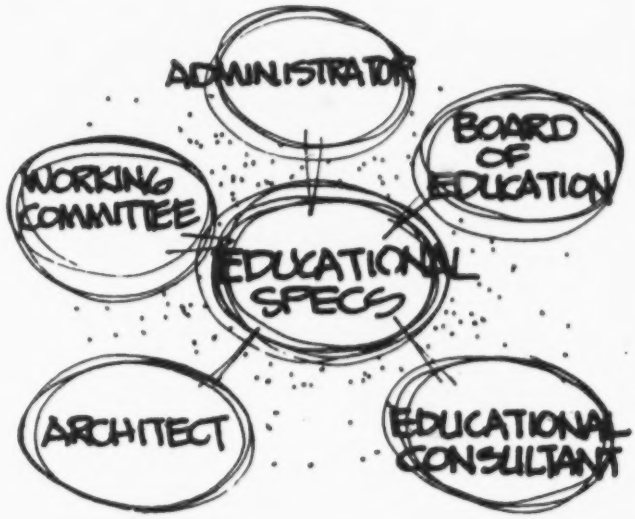
Administrator

- Recommends committee personnel.
- Provides leadership, guidance, and assistance to the working committee throughout the study.
- Evaluates the progress.
- Interprets the results to the board of education, the staff, and the citizens of the community.

The Working Committee

- Is responsible for the organizing and carrying out the study.

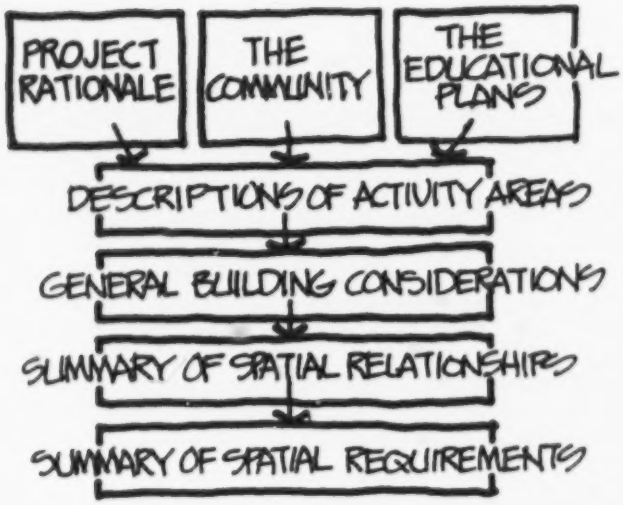
Photo courtesy of Project Simu-School



ED. SPECS TASK FORCE

EDUCATIONAL CONSULTANTS:
These are temporary employees of the school system who bring with them a considerable experience which may be lacking in the school system and an ability to broaden the spectrum of choices that the school system selects from. Educational Consultants are not designed to make your decisions for you. They can help you.

—*Stanton Leggett in SPACES FOR CAREER PREPARATION: PROCESSES OF PLANNING, Michigan Career Education Facilities Project, Published by CEFP, 1975.*



ED. SPEC. COMPONENTS

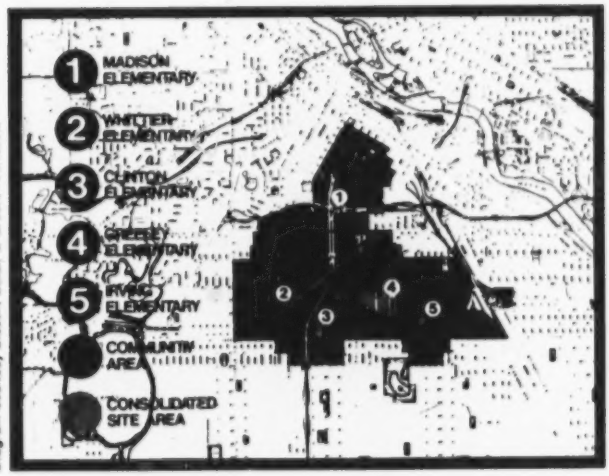


Diagram courtesy Bissell, Belair & Green, Architects

- Prepares a written report based upon the findings of the study.
- Reports to the administrator through the chairperson.

Educational Consultant

- Provides guidance, resource materials and planning information.
- Interprets discernible trends and new programs.
- Coordinates and motivates the work of the committee.
- Assists in the editing of the finished specification.
- Interprets the finished specifications to the design professions.

Architect and Landscape Architect

- Act in the capacity of observers and consultants during the program development.
- Serve as advisors on architectural and site development considerations.

Educational Specification Components

Setting down the physical requirements of the educational program is a way the educator can assist the architect in understanding activities, purposes, relationships and needs related to the proposed facility(ies). The educational specifications should state what is good educationally, not what may be common practice. The statement should not be limited by economic constraints, provincialisms, or other restrictions. It should be concerned with attaining improved — hopefully optimal — educational experiences and conditions.

Educational specifications should adhere to a definite format and should provide information related to the following matters:

Project Rationale
The Community
The Educational Plans
Descriptions of Activity Areas
General Building Considerations
Summary of Spatial Relationships
Summary of Spatial Requirements

The following outline is recommended.

I. Project Rationale

This section should provide a brief description of the planned project — why the facility is being built, its intended use, and the general purpose it is to serve.

II. The Community

A brief description of the community's history and its citizens should be developed. Maps showing the location of the community and the proposed attendance area for the school, as well as a third map or drawing showing the site for the proposed project

should be included.

III. The Educational Plans

This section can be subdivided to discuss three areas:

A. Curriculum Plan — This is a statement of the school's philosophy and a listing of the goals and objectives of the program. This simple, concise statement will clarify important issues for the planning committee and will allow priorities to be conceptualized. Its importance for the architect should be obvious.

B. Instructional Method — The instructional methods used to attain the goals and objectives identified above should be identified.

The statement can be rather general, but should clarify such matters as team teaching, open structure, etc. which will affect design of learning spaces.

C. Support Plan — The school's administrative staff, including such managerial personnel as principals, vice-principals, departmental chairpersons, administrative assistants, etc., should be identified.

Teachers, paraprofessionals, food service personnel, custodial personnel, counselors and so forth should also be noted.

IV. Description of Activity Areas

This section of the educational specifications describes instructional areas (regular classrooms, science labs, industrial arts spaces, physical education areas, etc.), administrative areas (offices for administrators, guidance and health personnel), and service areas (media center, cafeteria, food service areas, custodial areas, etc.). The following information for each of these functions should be provided:

A. Goals — Identify the goals and/or objectives for the activity area.

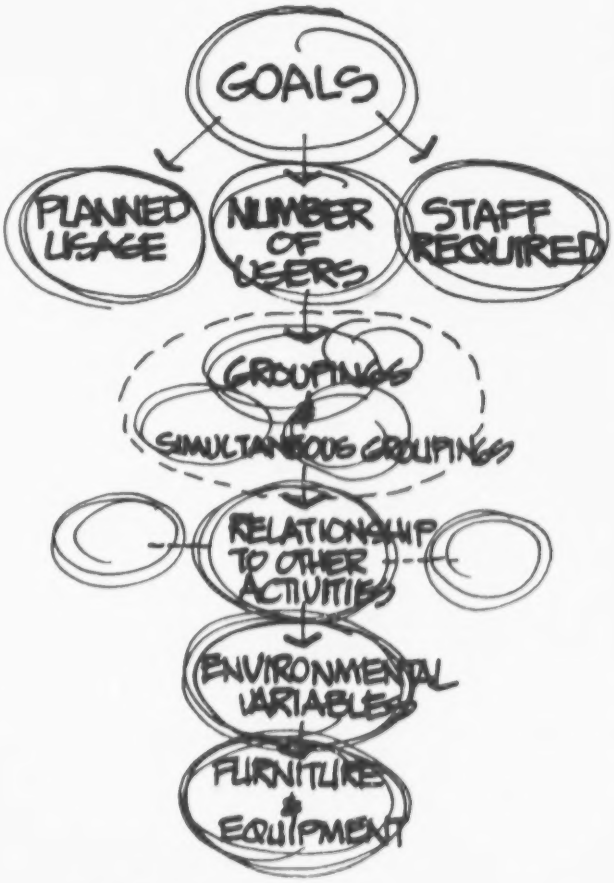
B. Planned Usage — Identify the experiences and activities planned for users of the area. Verbs describing specific actions such as paint, read, write, are more acceptable than general descriptions such as work, study, or interact. The architect should not have to imagine what will occur in the area.

C. Number of Users — Identify how many teachers, students or other persons will use the space.

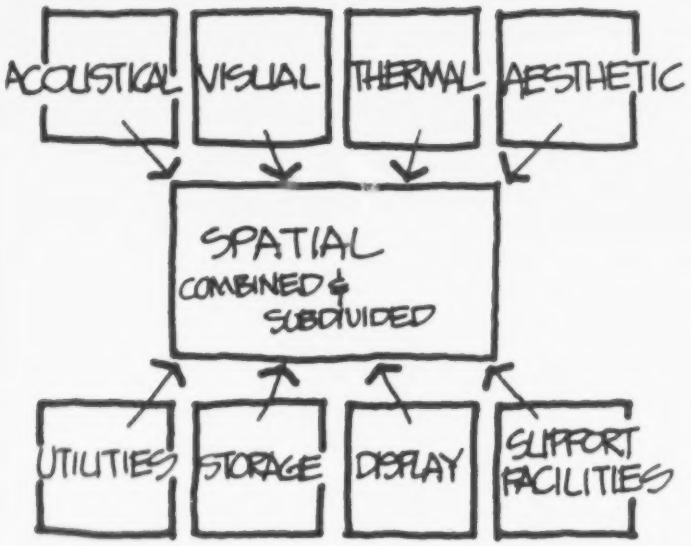
D. Staff Required — Identify how many teachers, para-professionals or administrative personnel will be in the area.

E. Groupings — Identify anticipated group sizes. For instance, for classroom space, this information should include a notation regarding large or small group instruction, individual student work, team organization, and so forth.

F. Simultaneous Groupings — Identify which of these various groupings will take place at the same time and the nature of the activities.



DESCRIPTION OF
ACTIVITY AREAS



SPATIAL COMPONENTS

G. Relationship to other Activities — Identify the spatial relationship of this activity area to other spaces inside and outside the building. These relationships can be described as direct, indirect and convenient.

H. Spatial Requirements — Identify spatial requirements for the area including capability for being combined with other areas to create a larger space, capability for being subdivided, the frequency of such adjustments, and the approximate square footage required for each area and its support areas.

I. Support Facilities — Briefly describe the support facilities that will enable the educational program to take place in the activity area. Student project areas, conference rooms, preparation areas, teacher planning areas, and shared storage areas are examples of support facilities.

J. Environmental Variables — Information should be provided concerning these four environmental factors:

1. Acoustical: Identify the acoustical needs of the area. Which activity areas should be enhanced or isolated acoustically?
2. Visual: Identify needs for visual access or separation. If the space is to be used for audio-visual presentations, should the total area or one part of it have the capability for being darkened?
3. Thermal: Identify thermal requirements such as equipment for year-round use, ventilation, elimination of excessive heat generated by special equipment, etc.
4. Aesthetic: Special aesthetic concerns should be identified, including the desired ambience. Colors, shapes and textures could be suggested.

K. Utilities — Identify the utility needs for the area, including hot and cold water, electrical requirements (both 115 and 220), gas, vacuum, compressed air, telephones, two-way public address systems, and closed circuit television. It might be helpful to identify the number of outlets for each of the above as required.

L. Storage — Identify the storage requirements for the activity area in terms of cubic feet required as well as the materials to be stored. This section included mostly specifications of built-in features.

M. Display — Identify display requirements, i.e., chalkboards, tackboards, pegboards, tack strips, and display cases. Approximately how many square feet of these items are required?

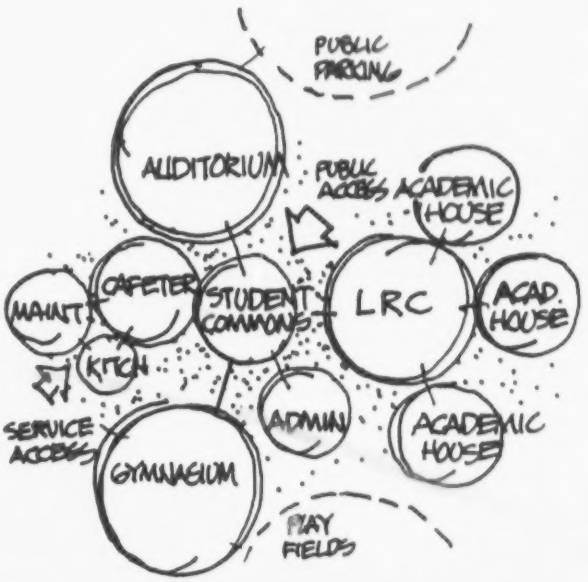
N. Furniture and Equipment — While it is not necessary to identify manufacturer's model numbers, styles, colors, etc., it is important to specify the quantity and type of item that will be used in each activity and support area. The architect will then have a feel for the equipment and furniture needed and will also

be able to verify that the items identified will fit into the space suggested in H above.
O. Others — Identify any additional essential information.

V. General Building Considerations
Although this section contains information about the total building complex, references to specific areas and concerns may be appropriate.
A. Health & Safety — Convey to the architect particular concerns regarding the health and safety of the building's occupants and persons arriving at and departing from the facility. Are there any local, state, or federal regulations which should be considered?
B. Economy — Identify the economic constraints within which the architect must work, including such factors as community feeling about the investment of money in quality materials which require a minimum of maintenance, etc.
C. Flexibility — To what degree should flexibility be designed into the facility? Should provisions be made for expansion — if so, in what areas? Will any activity be reduced or eliminated in the future?
D. Circulation — Both internal and external circulation patterns should be considered. Anticipated traffic patterns — and whether they will be heavy or light — should be suggested.
E. Community Use — Specify the time and nature of community use of the facility and how such use will affect the design of mechanical and security systems.
F. Communication Systems — Public address system, closed circuit television, and telephones should be considered.
G. Accessibility — This section should identify how students will arrive at school — the percentage of bused students, those arriving in private vehicles, walking, bicycling, etc. Staff, student and visitor parking requirements should be suggested. Service access should be detailed. Provisions for handicapped persons should be outlined along with applicable state and federal legislation.
H. Building Security — What provisions should be made for building security? Are there particular systems to be used or particular areas to be treated for maximum security? How will the security system affect community use?

VI. Summary of Spatial Relationships
Spatial relationships between activity areas should be summarized either in a matrix or bubble-type diagram. It may also be desirable to show some internal relationships within activity areas. Basically, this section summarizes the information in *IV*-G above.

SPATIAL RELATIONSHIPS
ELEMENTARY SCHOOL



SPATIAL RELATIONSHIPS
HIGH SCHOOL

SPATIAL REQUIREMENTS FOR A TYPICAL ELEMENTARY SCHOOL PROGRAM

	(Sq. Ft.)
2 Kindergarten	2400
3 1st Grades @ 900	2700
3 2nd Grades @ 900	2700
3 3rd Grades @ 900	2700
3 4th Grades @ 900	2700
3 5th Grades @ 900	2700
Multi-purpose room incl. cafeteria	3000
Kitchen, etc.	2400
Art suite	2200
Science & Math	2800
Learning Resource Center	5000
Physical Educ., Gymnasium	8000
Locker rooms	3400
Offices, Administration, Teacher lounge, etc.	1600
Total Net Usable Area	44300
Add for circulation, walls, services, etc	18700
Total gross area (for 544 students = 114 sq. ft./stu)	63000

Note: The table above is intended to serve only as an example. Do not interpret as recommended areas.

VII. Summary of Spatial Requirements

This is a list of all net program square footage as identified in ***IV***-H, above. A total net square footage should be identified as well as gross square footage requirements within which the architect must work (if such requirements exist).

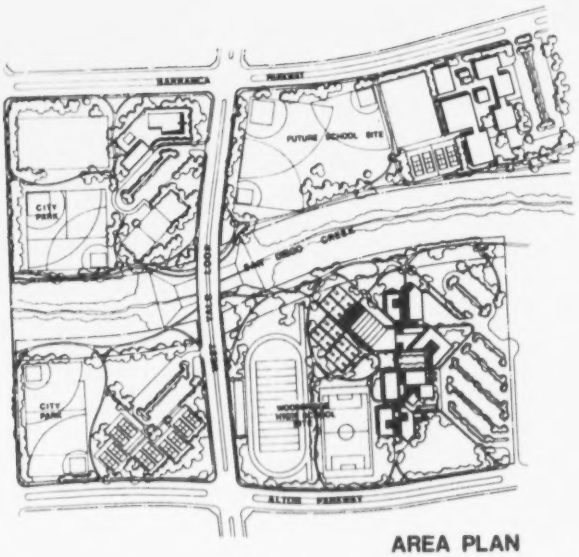
The educational specifications document is the basis upon which the architect will develop the schematic design for the projected facility. It can also be used in evaluating the facility when completed. Educational specifications should be thoughtfully, thoroughly and clearly developed. Their effectiveness is dependent upon the skill with which they are produced and the imagination and understanding with which they are interpreted.

F

THE SITE

Roche Miette Elementary School, Yellowhead School Division, Hinton Alberta.
S. Siren Architect, Hinton, Alberta.

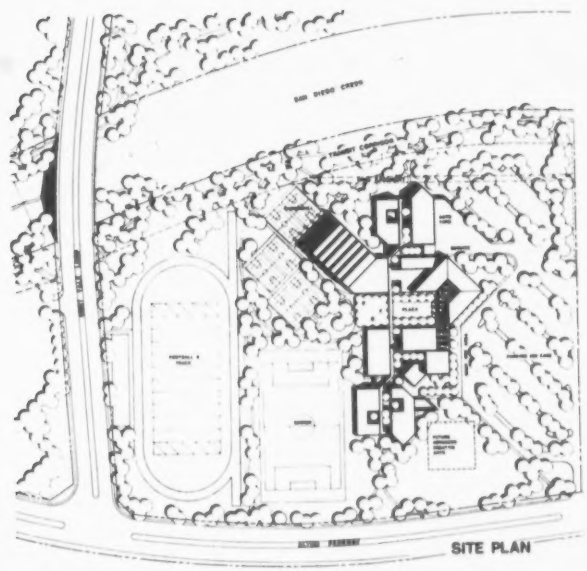
PERKINS & WILL AREA PLAN



AREA PLAN

Woodbridge High School, Irvine, CA.

PERKINS & WILL SITE PLAN



SITE PLAN

Woodbridge High School, Irvine, CA.

The subject of "the site" involves locating a place to accommodate a particular program or function. While "the site" has traditionally pertained to land only, it may also include facilities.

Intelligent and imaginative site selection and development are significant aspects of educational facility planning, whether in locating a single building or a college campus. The site affects the educational program, cost, transportation needs, enrollment, landscaping, and numerous other factors including the value and land use characteristics of the surrounding area. Because the design and use of the land on which a facility is located is as important as the facility itself, the site's potential as an educational and community resource should be understood and used.

Like other aspects of educational facility planning, site selection increases in complexity as its implications are more fully realized. Possibilities for site development have assumed a new dimension. Planners who have traditionally attempted to locate educational facilities on accessible, beautiful, well-drained land have had to enlarge their perspectives to accommodate some immediate social, political, ecological, economic, and educational issues. The advent of environmental education, the importance of racially balanced enrollment, the imperative for conscientious energy use, the high cost and scarcity of urban land, and the desire for extended/community use of educational facilities are some of the conditions that site planners must now consider.

This unit examines a variety of site selection considerations and explores general aspects of site planning. It focuses on the site selection process by identifying who does it and when, and what resources are available. It identifies site selection criteria. This unit also considers how land is obtained and how it can be used to full advantage.

The Site Selection Process

What is to be done? The selection of a suitable site is one of the first steps in attaining the goals outlined in an educational specification. The siting process begins with a definition of important site factors and proceeds to a search for suitable sites, and selection and acquisition of the best site. It concludes with the preparation of a site development plan.

What is the procedure? Typically, a selection team is assembled and directed by the educational administrator. A list of site requirements is prepared based on information about the projected facility and program needs; other basic information may be contributed by cooperating or regulatory agencies and organizations. As potential sites are examined

and the choice of acceptable sites narrows to the most promising two or three, some testing or inspection by licensed professionals may be required. The owner normally pays for these services if they are required. After evaluating these results, the selection team recommends a site(s) to the appropriate governing board. The board may then authorize purchase of the land on which the new facility will be constructed or approve the selected site if it is already owned. Depending on laws, the electorate may be asked to approve appropriation of funds for purchase.

When should site be considered? During the 1950s and early '60s when steady growth was common in many educational institutions, it was considered advisable to choose and purchase sites on the basis of projected need. Such foresight could insure the availability of land in proper quantities in desired locations. It was also advantageous economically because early purchase could avoid escalating costs. Contemporary low-growth enrollment conditions and projections usually do not require this anticipatory approach to site selection and acquisition. Responding to rapid growth is not a current challenge in most administrative units, therefore, sites can be selected and purchased as necessary and in terms of known or projected needs. A more astute site selection can normally be made under these conditions because educational specifications will already have been developed. The planners know who will be served by the facility and the site and how the land will be used. This procedure is obviously more reliable than one based on assumptions about the future.

Who does it? The selection of a site and the formulation of general plans for its development require a well-coordinated team effort by informed persons. Educational administrative official(s), the architect, the educational consultant and department of education officials are often the primary decision makers. They should use the assistance of landscape architects, urban and regional planners, engineers, recreational experts and legal consultants. Persons involved in site selection for educational facilities should have a thorough understanding of program needs outlined in the educational specifications; they must recognize and consider all factors affecting the site. They are responsible for making decisions regarding site criteria, specifically (a) What will be its use? (b) Where should the site be? (c) How large should it be? (d) What characteristics should it possess? and (e) Does it meet development rules and regulations? Team members should understand site development possibilities and appreciate

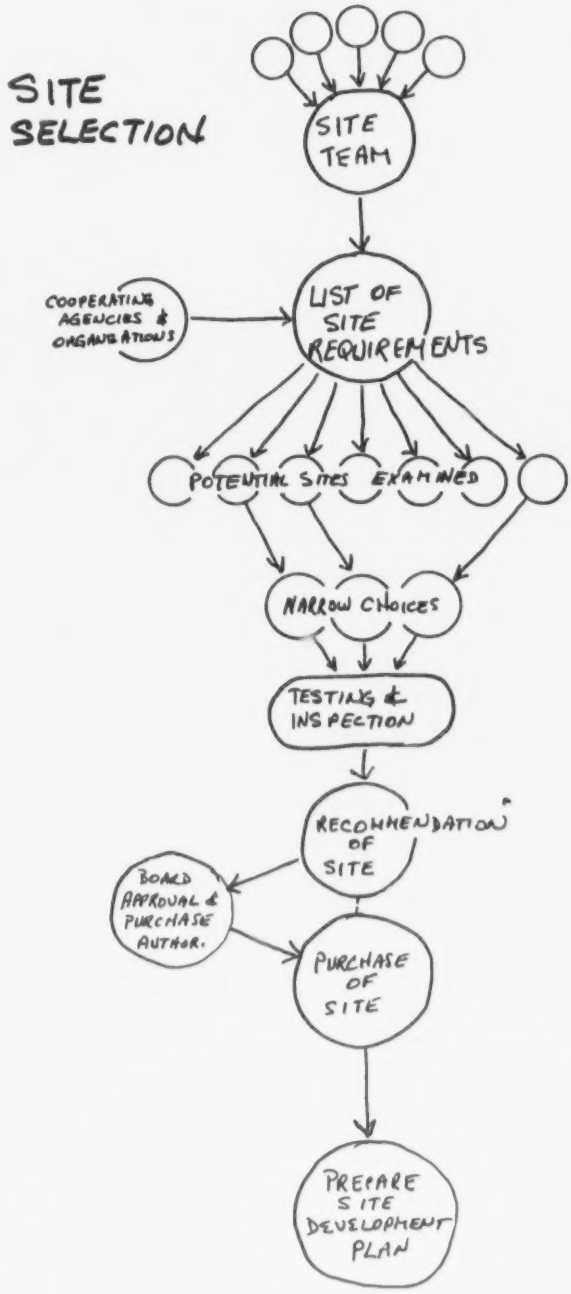


Figure 1

the importance of a well-chosen, fully-utilized site. The main objective of their work is to obtain and develop an optimum site.

Who does what? Each member of the site selection team will have a particular role to play and special expertise to contribute to the process. How each professional can facilitate the site planning process is briefly outlined below. Those who can assist in an advisory capacity are also mentioned. Some of the job descriptions given here are not the exclusive domain of any profession, particularly in the cases of the civil engineer and landscape architect.

The *architect* can determine which site characteristics will best accommodate the building design suggested by the educational specifications. He or she can also provide valuable information about the suitability of various sites. The architect can produce preliminary sketches indicating how buildings can be located on the proposed site, thus bringing out good and undesirable site features.

The *civil engineer* makes a boundary and contour map of the site. The map is particularly important if the site is irregular and of questionable suitability. The contour map provides insight into building placement and site development.

The *landscape architect* performs both analytical and design functions. He or she can assist in placing the building on the site for the optimal development of the total area and can provide information on topography, soil quality, drainage, and development potential including energy conservation considerations. The landscape architect may prepare an inventory of all pertinent site features. During later planning stages—after the site has been officially designated or acquired—this person can be involved in designing roadway and parking systems, locating walkways, athletic fields, play areas, and outdoor learning areas, determining appropriate plantings, and planning land contour.

A *testing laboratory engineer* can determine if soil conditions will support planned construction. For instance, if the site features a slide area, water seepage, or similar problems, the testing laboratory engineer can assess the load-bearing capacity of the soil and can specify necessary compensations. The costs of extensive testing should be avoided until plans have been developed to locate the building(s). If sewers are nonexistent, the engineer can determine if the soil will permit the percolation of water so that a sewage disposal system can be established.

A *real estate appraiser* can judge if the cost of a site is reasonable. He or she may conduct a study that

SITE SELECTION TEAM

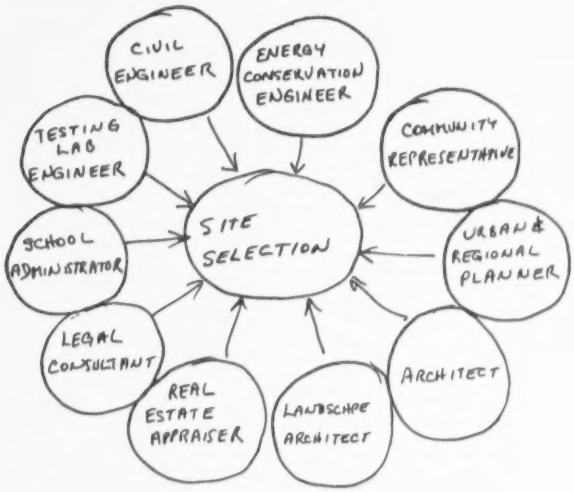


Figure 2

will include photographing the site and comparable real estate, determining prices of other property recently sold in the area, and ascertaining alternative land uses. A real estate appraisal is particularly important when an educational institution initiates condemnation proceedings in an attempt to acquire a site. When the right of eminent domain is exercised, the appraiser submits evidence on property value to the court. The court then rules on a purchase price that is fair to both owner and buyer.

A *legal consultant* should examine all legal documents and advise the governing board and officials on legitimate procedures for property acquisition, whether by purchase, gift or condemnation.

Urban and regional planners are experienced in the use of techniques for analyzing and mapping areas to help locate sites. Their tools include soil maps, aerial photographs, topography maps and highway maps. They can advise on zoning regulations and highway construction.

An *energy conservation engineer* can propose ways to minimize energy consumption in both siting and building the project.

In some cases a *community representative* may be included on the site selection team to convey the concerns and desires of the local community.

What Resources Are Available?

The facilities master plan and the educational specifications documents described in earlier units contain essential information about the people, program, and building for which the site will be used. The skills and knowledge of the site selection team and its advisors are additional resources. The following sources can also help in site selection.

Comprehensive regional, urban or community plans will show intended land use. These are reliable only if adopted and if adjusted to changing conditions and rates of growth. Most communities, local governments or regions maintaining full-time professional planners will have developed such documents. In larger areas, a full-time planner may be assigned to assist educational institutions in locating sites and developing long-range plans. The planner will provide information on existing land use, community facilities needs, transportation, zoning ordinances and demographic data.

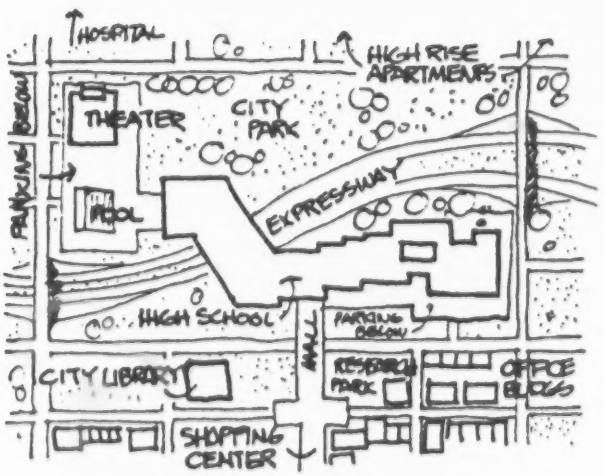
Aerial photographs and photomaps help identify available lands for school sites. They also detail land improvements. Photographs may be available in stereopairs, which can create a three-dimensional image of land characteristics. Aerial photomaps are generally useful and more economical because of

Photo courtesy Skidmore, Owings & Merrill

Figure 3

Diagram courtesy Ingham Intermediate School Dist., Mason, Mich.

Figure 4



MASTER PLAN
URBAN SCHOOL SITE

Figure 5

the printing process. They lack the definition of a photograph, but they are adequate for identification purposes. Photomaps may be obtained at cost or may be borrowed from a local planning office. Recent photographs should be obtained because updating and cross-checking old ones against land ownership changes and building permits is time-consuming.

Topographical maps can often be obtained from an appropriate government agency (e.g., the U.S. Coast and Geodetic Survey). In rapidly growing areas it is possible to obtain maps made from recent aerial photographs; however, they are occasionally general and inaccurate. In some instances, preliminary working prints (blue line) can be obtained from regional offices. Published topographical maps that are color-coded and keyed to a legend of standard symbols are generally at least three years old; the best available are the 7½ minute maps at a scale of 1:24,000. State index maps are also available that show quadrangles by name, date published and scale. A check with local engineering offices, both public and private, may reveal the existence of appropriate topographical maps and legal descriptions of land under investigation. As site choices are narrowed, these topographical maps may be enlarged and logical contours plotted at more frequent intervals so that the architects can prepare schematics on site development.

Highway maps can be obtained from the district engineering office of the state or provincial highway division. City and county engineering offices are other sources of local maps and plans useful in analyzing vehicular and pedestrian routes.

Property ownership maps are located in city or other local government recorder's offices or are filed with the registrar of deeds. These documents name current owners and provide legal descriptions of property, including deed restrictions, covenants, and conveyances, easements, rights of way, sight line and building height restrictions, and reversionary clauses.

Information about physical characteristics is usually available through official and unofficial sources. Maps and diagrams showing the soil classifications, sub-surface characteristics (geological formations), rift zones (earthquake faults), flood plains and control measures, and weather data should be examined when available.

Urban development data provide house counts, empty lot counts, and information about utility lines, telephone connections, real estate transactions and building permits. To test enforcement of zoning and

assess the possibility of undesirable encroachment near a potential site, granted zoning variance requests should be examined.

Federal agencies maintain records on the location of airports, waterways, parks, recreational areas, wilderness areas and agricultural areas, and on transportation plans, labor statistics, census data, health and welfare services, and urban development. Most of these services and concerns are handled by agency offices at regional, state or provincial levels.

Public safety officials, including fire departments, police and the nearest Civil Defense office, should be contacted to ascertain how a potential site fits into the community's disaster and emergency relief program.

The *Environmental Protection Agency* can provide information on the environmental impact of the project.

Other sites, either in use or abandoned, should be considered. It is possible that an educational program may be best accommodated on an already-developed site.

Criteria For Site Selection

Each parcel of land identified as a potential site should be thoroughly examined to determine its suitability in terms of educational plan, accessibility, cost, size and numerous other criteria. Those responsible for site selection must investigate both present and possible characteristics of the site and the surrounding property. The resources mentioned above should be used in an attempt to answer at least the following questions:

Will the site support the educational program?
Is the site's location convenient for the majority of students?
Is the site the right size and shape?
Is the topography conducive to desired site development?
Is the general environment aesthetically pleasing?
Is the site safe?
Is the air quality healthful?
Is the site free of industrial and traffic noise (both air and ground)?
Does the land drain properly and are other soil conditions good?
Does the site have desired trees and other natural vegetation?
Is water available?
Are there easements of any nature affecting the use of the site?

Is the site suitably oriented for energy conservation?
Is the site located on a flood plain?
Is the site near other community services—libraries, parks, museums?
What is the relation of the site to existing educational facilities?
How is surrounding land zoned—will its development enhance the site?
Are utility services available?
Is the site served by public agencies—police, fire department, etc.?
Is the site easily accessible for service vehicles?
Can the land be shared with other community facilities and organizations, especially parks?
Will the site provide desirable open space for the community where it is needed?
Is the site available?
Is the site expandable in the future?
Is the site affordable? Are life-cycle costs reasonable?

It may not be possible to locate a site that will totally accommodate all needs. Compromise may be unavoidable where land is at a premium and choices are limited. For instance, no urban facility planner will reject a potential site because it does not offer pleasant vistas and an absence of traffic noise. Criteria must be adjusted to existing conditions and constraints. Nevertheless, the selection committee should discuss priorities and agree on what qualities are indispensable. Site deficiencies should be examined in advance so they are not a surprise after purchase, or worse, an obstacle to planned development.

Informed site selection may therefore consume much time and will require research, assessment of values, and some major choices. It probably will not be an easy process. Some additional considerations related to criteria for site selection are presented below.

Program considerations. Perhaps the most crucial question the site selection team must ask is this: will the potential site allow realization of the educational plan? All other questions are secondary to this issue. The educational specifications should be examined and their recommendations applied to each potential site in an effort to assess the compatibility of the site and its projected use. One method for determining how successfully a site responds to space needs is to make a trial layout. Information on educational policies, curriculum, type of educational institution, anticipated community use, and projected enrollment figures are necessary for such a study.

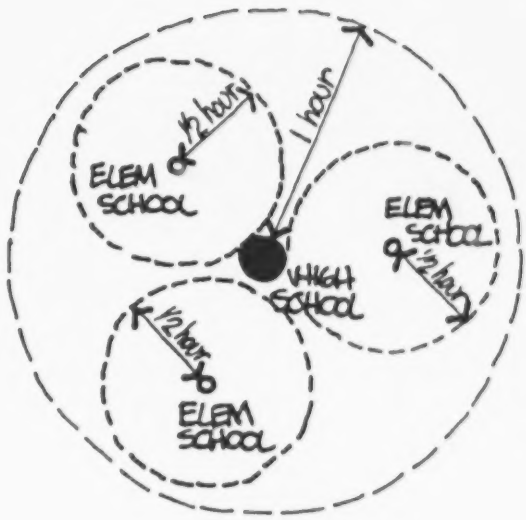
Centrality/accessibility. Sites for educational facilities should be located as near as possible to existing and proposed community facilities, including parks, recreational centers, galleries, libraries and health centers for easy access to these resources. If adequate land is available, sites should be located near the center of the probable future student population. Centrality of a site may be erroneously sacrificed for less costly or more desirable land that is remotely located. Planners should not lose sight of the fact that transportation of students is costly. (Good accessibility is therefore good energy conservation.) If busing is necessary, the site should be accessible from feeder streets and roads to simplify the safe loading and unloading of transported students.

Whenever possible, it is desirable to locate facilities within walking distance of the greatest number of students. These distances are considered reasonable maximums for pupils walking to school: three-fourths of a mile for elementary school students, and one and one-half miles for middle school, junior high and senior high school students. These travel times on conveyances are considered reasonable maximums for transported pupils: one-half hour for elementary students and one hour for secondary students. In some sparsely populated localities, longer travel times are considered reasonable.

School size (and, therefore, site size and number of sites) determines accessibility. Small schools are more accessible.

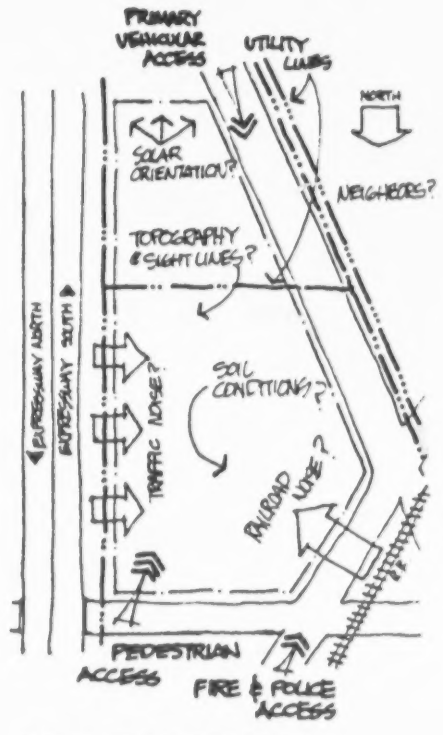
Relation to other educational facilities. If population growth or spread is anticipated, sites should be selected to avoid undue overlapping of areas to be served by different schools or institutions. In attempting to determine the geographic boundaries of such areas, at least six factors should be examined: (1) the student group to be served by each institution, (2) the permissible type of residential development because type of dwelling may affect enrollment, (3) transportation policy, (4) hazards and natural barriers affecting accessibility, (5) policy regarding maximum school or institution enrollments, and (6) racial characteristics of population to insure integrated enrollments.

Topography. It is desirable to select land with a slightly convex surface that is moderately elevated above the surrounding ground. Such characteristics can insure natural drainage and save the added expenses of grading and filling. If possible, land should slope towards the south to allow maximum use of passive solar energy measures. Test boring of a proposed site to determine its suitability to support buildings is always recommended. Surfaces



MAXIMUM
TRAVEL TIME
FOR TRANSPORTED STUDENTS

Figure 6



SITE FEASIBILITY
CONSIDERATIONS

Figure 7

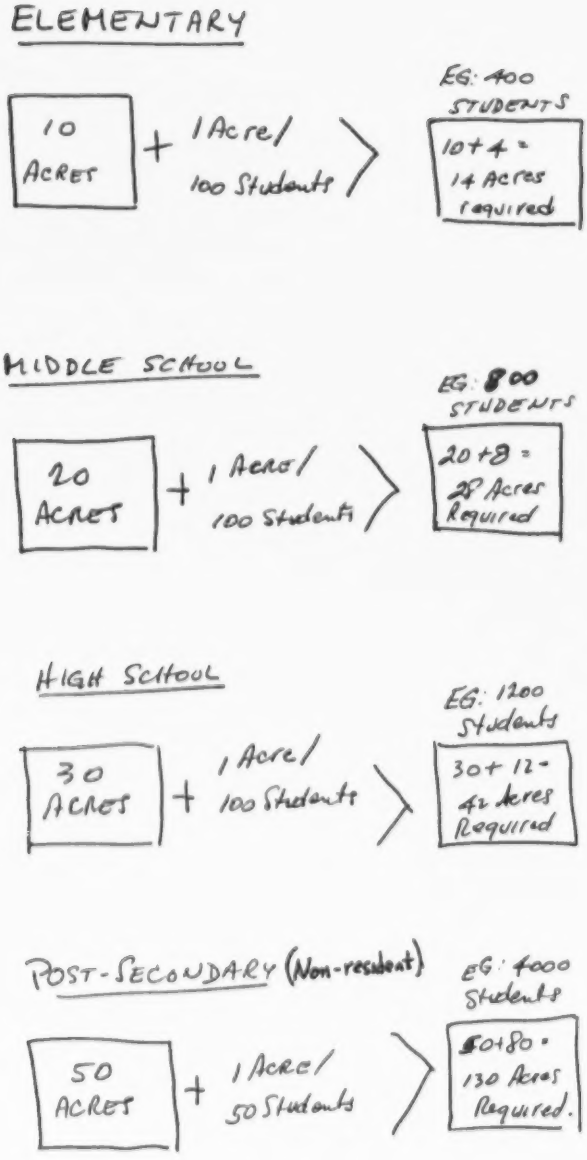

ELEMENTARY
10 ACRES + 1 Acre/ 100 Students
EG: 400 STUDENTS
10+4 = 14 Acres required
MIDDLE SCHOOL
20 ACRES + 1 Acre/ 100 Students
EG: 800 STUDENTS
20+8 = 28 Acres Required
HIGH SCHOOL
30 ACRES + 1 Acre/ 100 Students
EG: 1200 Students
30+12 = 42 Acres Required
POST-SECONDARY (Non-resident)
50 ACRES + 1 Acre/ 50 Students
EG: 4000 Students
50+80 = 130 Acres Required.

Figure 8

and subsoil that have been filled with debris are generally unstable; a site of this type may require deep and expensive footings or piles. The effect of topography on sight lines may also be considered.

Availability of utilities. A site should be located so that gas, water, sewers, electric power and other utilities can be provided at reasonable costs. The availability of utility services for a proposed site should be investigated before purchase because location can make an appreciable difference in the cost of connections. The expense of installing extensive runs of piping and wiring or of establishing a sewage disposal system could be prohibitive.

Availability of other services. Police and fire protection should be considered as well as the availability of garbage disposal service.

Zoning. Community zoning and future development plans deserve study before a site is purchased. Locations where future zoning might permit construction of factories, congested business centers, and noisy, hazardous transportation systems should be avoided. Cooperative planning with other agencies is vital to insure that such encroachments do not occur.

Size of the site. The initial site purchase should meet all the site size requirements because land adjacent to a new educational facility may not be available later. Site size should be determined largely by the nature and scope of the contemplated educational program.

The following standards have been useful to many planners (though it is not always possible to meet these standards, they may be helpful where land is available):

1. For elementary schools, it is suggested that a minimum site of 10 acres be provided, plus an additional acre for each 100 pupils in the projected maximum enrollment. Therefore, an appropriate site size for an elementary school with 200 pupils would be 12 acres.
2. For middle schools and junior high schools, it is suggested that a minimum site of 20 acres be provided, plus an additional acre for each 100 pupils in the projected maximum enrollment. Thus a site of minimum size for a middle or junior high school of 500 pupils would be 25 acres.
3. For senior high schools, it is suggested that a minimum site of 30 acres be provided, plus an additional acre for each 100 pupils in the projected maximum enrollment. Thus a site of minimum size for a senior high school of 1,000 pupils would be 40 acres.

4. For higher education (post-secondary) purposes a site of 50 acres plus one acre for each 50 students is desirable for a campus with no residential facilities and in an area where land is readily available. In a restricted or more urban setting this desirable goal must clearly be altered.

These standards apply to the suburban site. In an urban neighborhood the site will also be urban in scale and attitude. Instead of large lawns, courts and gardens, multi-floor buildings will somewhat reduce land needs. In these cases the dual use of land is a key factor.

Cost. In determining the reasonableness of the cost of a proposed site, many factors must be considered. Initial cost is only one part of the ultimate expense. A site may be costly initially but economical in the long run. Conversely, an inexpensive property may be expensive to develop. All factors related to both initial and long-range costs must be considered.

Disadvantages of poor site selection. Failure to address a complete list of site selection criteria can result in selection of a poor site. Poor sites may have a number of disadvantages: inability to meet all of the educational program requirements, higher than expected operating costs, inability to accommodate future expansion, susceptibility to change (for example, a planned highway may interfere with an otherwise satisfactory site). Careful planning will help avoid these types of pitfalls.

Site Acquisition

After all potential sites have been examined in terms of the criteria agreed upon by the decision-makers, a well-informed selection can be made. The chosen site may be acquired by one of five legal methods: (1) purchase from the owner, (2) acceptance as a gift from the owner, (3) condemnation of private property (with purchase at fair market value), (4) receipt of surplus government property, or (5) lease of government-owned property.

Outright purchase of property from the owner is usually the most satisfactory method of land acquisition. In most instances, governing boards are authorized to buy land for sites. Occasionally a site purchase must be approved by the electorate. Approval of site purchase by state or provincial agencies is mandatory in many cases.

Local citizens or firms may offer to donate land for a school site. If this is the case, several precautions should be taken before acceptance. The governing board should be certain it will have clear, unconditional title to the land and that there is no reversion

COMPARING ALTERNATE SITES

FACTORS	WT. FACT.*	SITE A	SITE B	SITE C	SITE D
		EACH FACTOR WEIGHED ON SCALE OF 1 TO 10 FOR DESIRABILITY			
		Raw Score			
Program Support	5	7/35	7/35	5/25	10/50
Ease of Acquisition	1	9/9	10/10	4/4	6/6
Cost of Site Development	3	10/30	6/18	6/18	9/27
Cost of Utilities	2	3/6	5/10	7/14	10/20
Aesthetic Quality	3	10/30	9/27	4/12	7/21
Location and Centrality to Student Population	4	3/12	6/24	8/32	9/36
Ease of Future Expansion	5	5/25	7/35	4/20	2/10
Future Land Value and Marketability	2	4/8	6/12	6/12	10/20
Adaptability to Future Grade Organization Changes	4	7/28	7/28	7/28	8/32
Cost	4	5/20	8/32	4/16	6/24
Total Evaluation (Weighted Score)		203	231	181	244

Product of raw score times weighting factor

*Factors weighted from 1 to 5 (for example) to describe importance of factor to specific project

Figure 9

clause. Also, the suitability of the free site should be judged by the same standards applied to other sites. If the site does not meet specified requirements, the cost of developing the land to the desired condition should be considered.

Condemnation is common in many areas but with varying conditions. Exercising the right of eminent domain allows public institutions to acquire land when the owner refuses to sell or when a price cannot be agreed upon. The land is appraised and the court determines a fair purchase price. Administrators and boards should use every reasonable effort to acquire land without court action, but because of the widespread, long-range effects of site selection, condemnation may be a justifiable and necessary site acquisition procedure.

When land owned by a government is declared surplus, it may be available free for sites. In such cases, those responsible for site selection and acquisition should study the suitability of the site in the way they would land donated by any other party. The same applies to sites that are leased from a government.

Laws affecting the securing of proposals for sale, appraisals, counteroffers and options should be investigated. Every effort should be made to guarantee that site acquisition is clear and legal.

Site Development

Guidelines for site development must be flexible enough to accommodate differences in the character of various sites, the types and sizes of facilities to be built, and the nature of the educational program. A well-developed site can assume a variety of forms because it will evolve out of existing natural features and the planned use of the site. Therefore, this section is less concerned with specific recommendations than with procedures and possibilities for site development.

Survey of essential site data. A logical starting point is the preparation of a survey of essential site characteristics. This inventory is analyzed and serves as a basis for the site design. The survey should provide at least the following information:

1. Title of survey, property location, certification, and date
2. Scale and compass orientation
3. Tract boundary lines, courses, and distances
4. Names of abutting property owners
5. Bench mark with assumed elevation
6. Names and locations of all existing road right-of-ways on or near the tract
7. Locations of all existing structures on the site,

including buildings, foundations, bridges, wells, cisterns, walls and fences, and rock outcroppings

8. Locations, type, size, and flow of all existing storm and sanitary sewers on or contiguous to the tract, including top and invert elevations of all manholes, and inlet and invert elevations of other drainage structures
9. Locations of roads, drives, curbs, gutters, steps, walks, paved areas and the like, indicating types of material or surfacing
10. Locations, type and size of all water and gas mains, meter boxes, hydrants, and other appurtenances
11. Locations of all utility poles, telephone lines, and power lines, with indication of nearest leads either on-site or off-site; pertinent information and ownership of all utilities
12. Locations of all swamps, springs, streams, drainage ditches, lakes, and other bodies of water; line of maximum flood plane if applicable
13. Outline of wooded areas; location of trees and plants, identification by type, identification of trees with trunks over eight inches in diameter at waist height, and identification of productive and non-productive plants
14. Road elevation for all improved roads on or adjacent to property; improved gutter elevations on property line side at intervals of 50 feet
15. Elevations throughout the site sufficient to develop a complete and thorough contour map
16. Construction of permanent property corners such as concrete monuments (optional)

This survey must be performed by a competent land surveyor who is properly registered. Incomplete or inaccurate information could have disastrous consequences later. Do not underestimate the importance of this survey.

The site development plan. It is now possible to begin developing a land-use plan that details solutions to land engineering concerns such as adjustment of grades and placement of parking areas, roads and walkways, landscape design, and plan of outdoor learning and athletic areas. These plans should be prepared concurrent with building construction plans. The procedure outlined below is a practical approach to the task.

1. Obtain a topographical survey of the site.

2. Make repeated visits to the site to gain a feeling for its character, to collect information, and to begin a land-use analysis. Usually the architect takes a print of the topographical survey

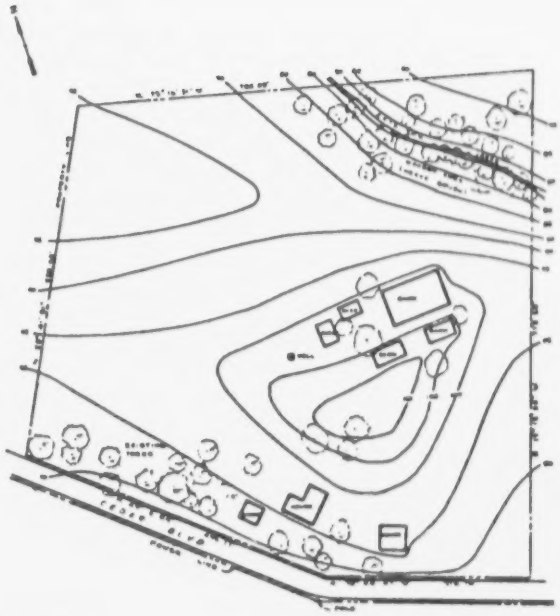


Figure 10

McDONALD FARM PROPERTY
JACKSON COUNTY, CALIFORNIA
A. W. TORRES, CIVIL ENGINEER 9-7-64

Illustrations courtesy California State Dept of Education, Bureau of School Planning Sacramento

McDONALD FARM PROPERTY
JACKSON COUNTY, CALIFORNIA
A. W. TORRES, CIVIL ENGINEER 9-7-64

Figure 11

BEST COPY AVAILABLE

directly to the field. From on-site observations, he marks down all pertinent information that might influence site planning such as views, sculptural land forms, quality of the soil, trees, outcroppings and streams.

3. Prepare diagrammatic studies based on all collected information and an understanding of the site. Many diagrammatic studies are needed to explore and evaluate alternatives. They are usually prepared by the architect in rapid freehand sketches, which are seldom shown to the client; yet, these studies are most critical for the development of ideas.

   The architect can benefit by collaboration at this point with the clients, facility planning specialists, landscape architects, engineers, and other experts, who, in a free interchange of ideas, generally contribute such specific information that the best plan concepts evolve spontaneously.
4. Develop a refined site plan. (The architect should not proceed beyond No. 3 until the school buildings are planned in detail.)

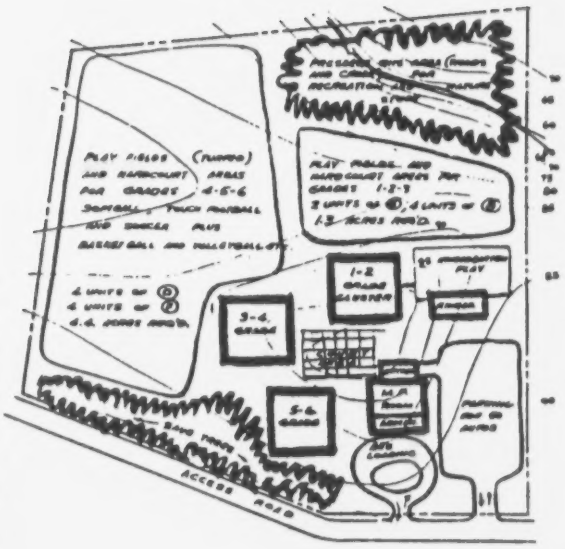
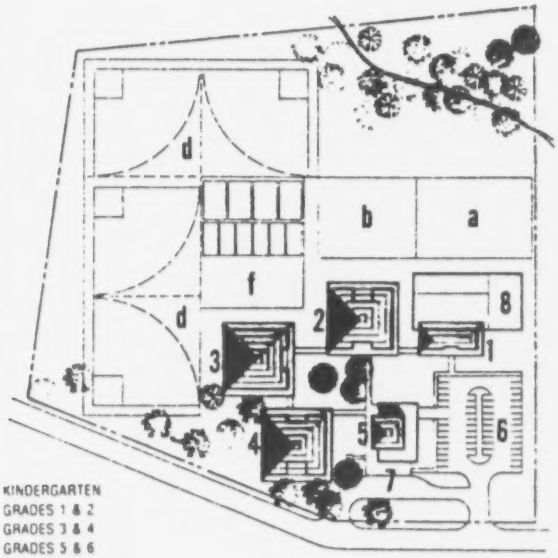


Figure 12



1 KINDERGARTEN
2 GRADES 1 & 2
3 GRADES 3 & 4
4 GRADES 5 & 6
5 M P & ADMIN
6 PARKING
7 BUS LOADING AREA
8 KINDERGARTEN PLAY YARD
a PLAYFIELDS:Grades 1 2 3
b HARDCOURTS:Grades 1 2 3
d PLAYFIELDS:Grades 4 5 6
f HARDCOURTS:Grades 4 5 6

Figure 13

Illustrations courtesy California State Dept. of Education Bureau of School Planning, Sacramento

Aspects of site development. There is more to proper site development and landscaping than positioning the building on the lot and planting a few immature trees and assorted evergreen shrubs. However, minimal site treatment is not uncommon and it may result from economic constraints, other priorities, or lack of information or imagination. Nevertheless, aesthetic and functional considerations and relationships must be examined, an able landscape architect must be retained, and funds must be allocated for site development in the initial capital outlay budget. The expense of developing an attractive site can be justified by numerous arguments: it pleases users and observers; it facilitates and encourages use by students, staff and community; it enhances the appearance of the building; it provides opportunities for learning and recreation; it is safe; it is less subject to vandalism than a neglected or barren site; it can facilitate energy conservation, e.g., by the planting of shrubs as windbreaks. Thoughtful and imaginative site development is a way of demonstrating respect for the natural environment; its significance in the educative process should not be ignored. (The same is, of course, true of the building itself.) Because of the importance of site development, attention should be directed to the following site-related matters.

Orientation of the building: The location of the facility on the site should be attractive and should allow

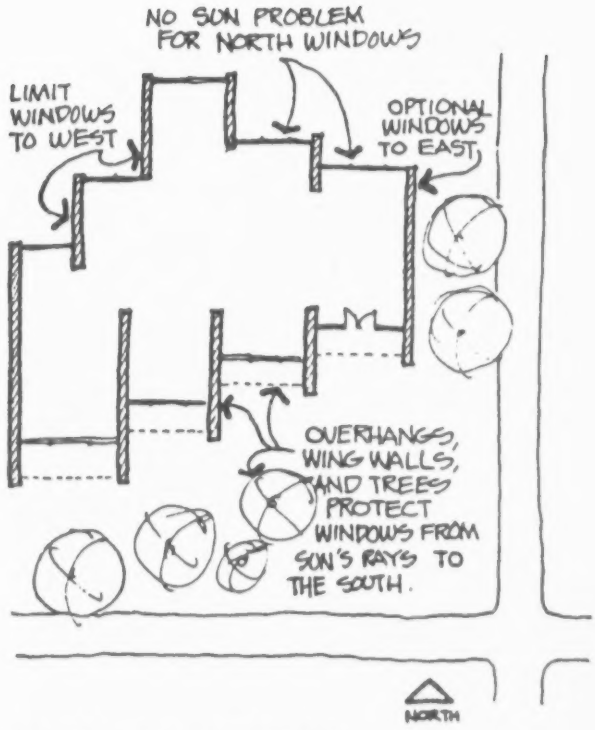
for the desired development of athletic fields and recreation and learning areas. It should avoid hazardous entrances on main thoroughfares. Approaches to sites should not require students on foot to cross main traffic arteries or railroad rights of way. If the site borders a highway, the main entrance drives, walkways, bus routes and loading spots should be designed with respect for the safety and convenience of users. Proper orientation is essential for both comfort and energy conservation. Windows should face south (with shielding to exclude high, hot summer sunlight while admitting lower winter sun) or east (since early sun is more acceptable than late afternoon sun) or north (no sun problem). Also, orientation with the prevailing breeze is desirable.

Walks: Walks should be designed to handle the volume and type of pedestrian traffic anticipated. Areas bordering walks should be treated in a manner that will endure wear. Walkways should provide direct and convenient access to and from the facility; otherwise, the users will create their own paths, which may damage shrubs and grass and create maintenance problems. Walks should not be paved until natural patterns of usage have been established.

Parking: Streets and thoroughfares near sites are for the movement of vehicular traffic, not for its storage. Cars parked parallel to curbing may contribute to traffic congestion. They may also create serious safety problems if students dart into traffic from between them. Off-street parking is considered essential by most authorities and educational facility planners. Adequate parking that is well designed for safe entrance and exit of traffic at peak hours is a key element in the selection of a site. Another major concern is to provide appropriate entrances and landscaping or grading that will avoid an "acres of asphalt-sea of cars" look. Circulation patterns should be analyzed to insure that arrival and departure of students, staff, visitors and service vehicles is separated from bus arrival and departure areas and pedestrian walkways. Safe travel and parking for bicyclists also should be provided.

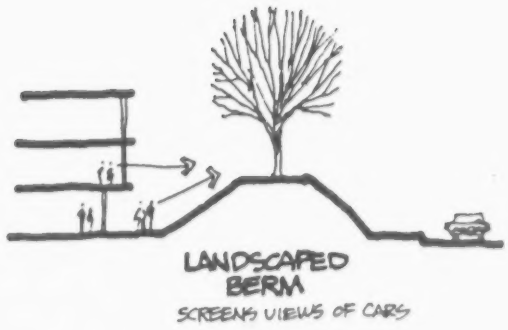
Lighting: Lighting of the site should promote safety and enhance the appearance and security of the building. Parking areas, pedestrian walkways, entrances and steps should be clearly illuminated.

Grading: Creative, functional grading of the site can improve the appearance of the building and provide screening from noise, wind and other climatic conditions. For example, earth berms, or mounding,


NO SUN PROBLEM FOR NORTH WINDOWS
LIMIT WINDOWS TO WEST
OPTIONAL WINDOWS TO EAST
OVERHANGS, WING WALLS, AND TREES PROTECT WINDOWS FROM SUN'S RAYS TO THE SOUTH.
NORTH

SUN CONTROL
WITH DESIGN ORIENTATION

Figure 14



Protects facilities from noise and may be used for the production of fruit and berries, as a windbreak or as for sun protection.

Figure 15

along highways can shield the site from traffic noise. Grading to create earth forms for climbing, sliding, and so forth is an inexpensive way to provide good recreational opportunities.

Vegetation: It is advisable to hire a landscape architect (if one is not a part of the architect's team) to plan and supervise the landscaping of the site. Respect for existing vegetation is encouraged; healthy trees growing on the site should be preserved. Later plantings should consist of varieties that are indigenous to the locality and that will respond well to light and soil conditions on the site. Lawns should be seeded or sodded. Trees—both deciduous and evergreen, shade and ornamental—as well as shrubs, flowers and ground covers should be selected and grouped according to height, color, and cultivation and maintenance requirements. Productive trees and shrubs could be given preference over purely ornamental plants, as a way to reintroduce the idea of self-sufficiency and self-reliance in food. Maintenance requirements may be lessened by mulching to reduce watering, weeding and the need for artificial fertilizer.

Vegetation also can discourage land erosion, mark boundaries, provide shade and shelter, channel pedestrian traffic, and provide visual and aural screening. The effectiveness of trees in reducing the amount of fuel used for air-conditioning buildings is an important energy conservation factor. In the summer, deciduous trees located near buildings can shade and cool; when leaves are shed in the autumn and winter, light and warmth are admitted.

Photo courtesy of Grand Rapids (Mich.) Public Schools

Outdoor learning spaces: The site is an immediately accessible learning resource. Soil, water, air, rocks, insects, and plant and animal life on the site can be studied, measured, sampled and experimented with. These features help students to learn about the natural environment and its interrelationship with human beings. Therefore, planners should preserve wetlands, streams, indigenous vegetation, rocks and other site features that can be used in the educational program. It may be desirable to set aside land for a productive garden and space for animals in order to provide experiences with self-sufficiency in food (a critical area for the future). Such spaces should be well drained and secure, and should offer shelter and storage.

Outdoor spaces for environmental education are not just a suburban or rural option. Small spaces on city school sites may be usable for growing plants and observing other living things. The city itself is an invaluable resource for learning about the built environment.

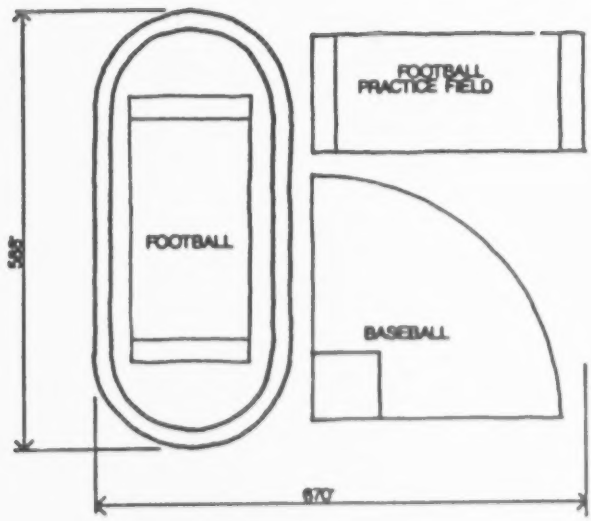
Gathering places: Areas where people—students, staff, and community residents—can gather, sit and socialize should be considered in the site development plan. With open school schedules that give students freedom to go outdoors during unscheduled time, gathering places are more important than in the past. If these spaces are comfortable, attractive and sturdy, they will encourage extended use of the school site. Also, spaces that are heavily used and that attend to human needs are less likely to be abused than those that ignore the users' visual and physical comforts.

Play areas for young children: School playgrounds should provide for strenuous physical activity like running, jumping, climbing and swinging. They should also provide opportunities for the development of manipulative skills, for game playing, building and imagining. Outdoor play areas should offer excitement and challenge as well as a chance for mastery. They should be safe and attractive—for children as well as most adults, this means a variety of spaces and natural features like trees, grass and other living things, not an asphalt surface punctuated with a couple of swings, a slide, a jungle gym and a basketball net.

Esperanza High School, Anaheim, California, William Blurock and Partners. Photo courtesy of Janet Isbell.

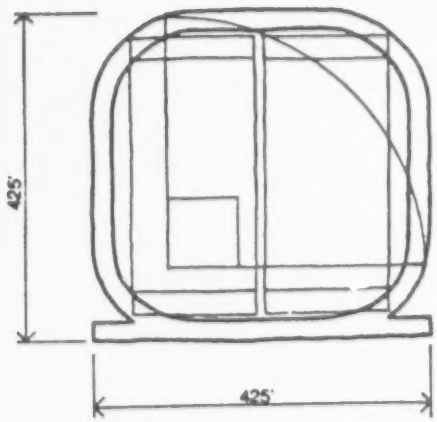
Outdoor play facilities may include both hard and soft surfaces, sand boxes, nature trails, gardens, ponds, hills and rock piles, as well as areas for games and fixed and moving apparatus for physical development. Children should have an opportunity to come into contact with natural and man-made objects that provide a variety of visual and tactile experiences. Many appropriate play items for younger children are inexpensive—some of them may fall into the "junk" category, like old tires, lumber and barrels out of which children can create shelters, lookouts or whatever else is fun at the moment. Adventure playgrounds allow children a chance to cooperatively plan and build their own ever-changing environments; they are a possibility for site development that planners should investigate.

Playground equipment: Playground apparatus and equipment should be carefully selected. Merry-go-rounds, ocean waves, swings and giant slides are of questionable value because they provide little exercise and are often dangerous. The use of rings, horizontal bars, and horizontal ladders affords good exercise for older children. Some schools have effectively used large drain tiles as crawling tubes for small children. Drain tiles provide good exercise but they are hard on clothing if they are not placed a little above the ground and kept clean.



CONVENTIONAL TRACK & FIELD LAYOUT
9.05 ACRES

Figure 16



PROPOSED TRACK LAYOUT
4.14 ACRES

COMPARED TO 9.05 ACRES REQUIRED FOR CONVENTIONAL LAYOUT, THIS REPRESENTS A SAVINGS OF 4.91 ACRES

BASED ON $2/SQ. FT. (MIN. PRICE FOR URBAN LAND) THIS SAVES AT LEAST $425,000

Diagram courtesy Graham Nathan Bruene Architects

Figure 17

Locales that use metric measurements must make the necessary conversions

Only equipment of sturdy construction should be selected. It should be erected under the direction of competent persons familiar with its use and the wear and tear to which it will be subjected. All joints and moving parts should be provided with safety guards to prevent pinching and shearing action. Hard surfaces under climbing equipment should be covered with soft, sanitary material to reduce injuries. Ease of supervision, safety, and economical use of space are considerations in locating equipment. Apparatus may be placed to advantage near a school building where the noise created will not be a problem and where it is readily accessible. If revolving or swinging apparatus is used, it should be placed either along a fence where there will be little danger of children running into it, or safety railings should be provided. The lines of motion of adjacent pieces of apparatus should be parallel to reduce cross motion. Ample space for safe use should be provided around equipment, but it is advisable to have it grouped so space is not wasted.

Play areas and athletic fields for older persons: Larger outdoor play spaces are often required on sites used by older children and adults. Courts and athletic fields for both informal and organized games should be provided. These may include facilities for softball and baseball, tennis, football, volleyball, archery, track, field hockey, swimming, or any other sport offered by the school's physical education and recreation program. Additional facilities may be developed in cooperation with community groups to encourage and accommodate adult use and participation in lifetime sports.

Intramural, interscholastic and intercollegiate athletics are commonly a part of the total educational program. The type and quality of special facilities for athletic programs will depend on the available funds and on the importance attached to competitive sports by the school's students, staff, parents, alumni and community. However, interschool athletics, football for instance, may neccessitate the construction of a stadium and playing field as well as lighting, spectator auto parking, traffic routes that do not interfere with other site development possibilities, facilities for ticket sales and collection, refreshment sales, toilets, a public address system and team rooms.

Community use: Possibilities for community use of the site should be thoroughly explored. The wastefulness of limited site use—closing down for evenings and long vacations—is not defensible. The educational facilities and site are community resources and can operate as such without disrupting the educational program.

Urban Settings

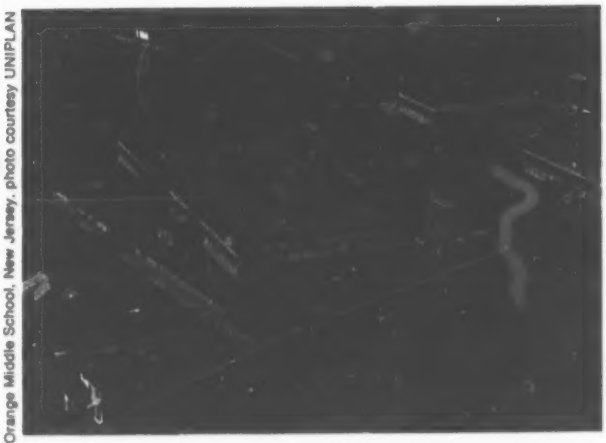
In older cities, acute congestion and high property values make acquisition of sites for both new construction and expansion of existing facilities very costly and complex. Where choices are limited by financial and physical constraints, the need for establishing priorities is vital. Efficient use of space is imperative. Urban facility planners must be especially imaginative and resourceful in the use of available space and existing buildings.

Possibilities for building and site design must be considered that are unnecessary in most suburban and rural areas where expansiveness is taken for granted. For instance, consideration might be given to elevating the educational structure so that recreation areas can be constructed beneath it, constructing a multi-story building with elevators or moving stairs, putting recreation and physical education areas on the roof, building some facilities (such as heating plants, parking and storage areas) underground or locating them remotely, or placing parking beneath stadia or other buildings that have a high degree of community use. Regarding playfields and outdoor instructional areas, it may be possible to: (1) plan for multi-use of the same area at different times of the day or during different seasons, such as having football practice fields, baseball practice fields, or areas for unorganized recreation in the same space; (2) stagger recreational periods so that only a portion of the student body would be on the playfields at any one time; (3) construct the building adjacent to a public park or playground that could be periodically used for recreational purposes; (4) provide fields for athletic practice and games in an outlying area where land is less expensive.

In urban areas, the advantages of community use are obvious. Because of their proximity, the educational facility and neighborhood are intimately related. In developing its site, the institution should not attempt to isolate itself and shut out the community. Furthermore, it need not confine its program and activities to owned real estate and neglect educational opportunities within the neighborhood. Determining community needs, developing a site that is responsive to those needs, and exploring possibilities that cannot be provided on the immediate school site are important concerns for the urban facility planner.

Joint Occupancy

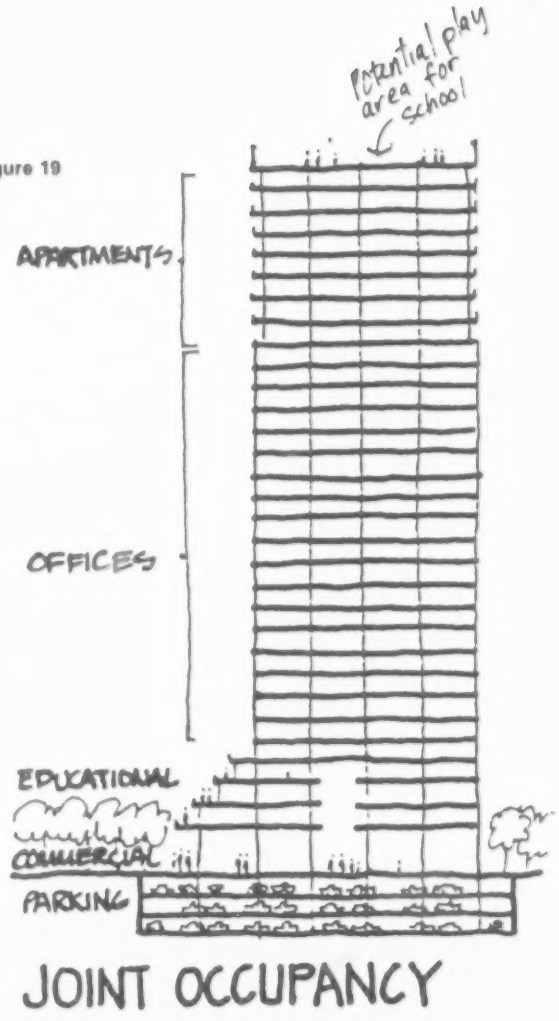
For sites confronted by economic problems and/or the inability to expand physically to accommodate programs and students, joint occupancy offers a



East Orange Middle School, New Jersey, photo courtesy UNIPLAN

Figure 18

Figure 19



F-19

viable alternative. Joint occupancy or mixed use could mean the educational program shares a building with other programs or occupies a building on a site that is shared with other programs. Schools have successfully entered into joint occupancy situations with commercial, housing, civic and recreational operations. They have shared space with health services, parking lots and business offices. Mixed use of urban sites in particular can save money. In cases where the educational institution owns and leases the developed property, joint occupancy can support the institution. It responds to the need for conserving space, which is inescapable in cities, and it helps to integrate the educational institution and community. Joint occupancy requires legal arrangements and collaborative planning (which is more complex than working out site problems related to the educational facility alone).

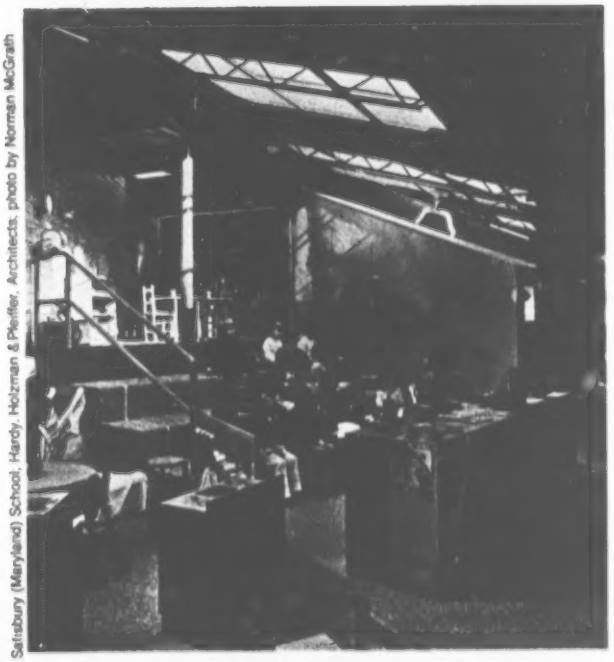
G

SPACES FOR LEARNING

Bellflower Elementary, Richard Fleischman Architects, Inc.

Norwell (Mass.) High School;
The Architects Collaborative, photo by Steve Rosenthal

Walt Disney Magnet School, Chicago; Perkins & Will, Architects



Salisbury (Maryland) School; Hardy, Holzman & Pfeiffer, Architects; photo by Norman McGrath

Spaces For Learning

The school environment affects attitudes and it affects behaviors. The character, appearance, and physical arrangement of the learning environment convey distinct messages to the users about the activities and responses which are expected and appropriate. The environment also operates in a practical way to enhance or interfere with the operation of the educational program. An obvious example of the interrelationship of learning environments, the educational program, and the users can be found in the difference between open classrooms and traditional ones.

Classrooms designed for open learning often feature separate learning centers for the exploration of science, math, social studies, reading, painting, and so on. Spaces for large group gatherings, tables for small group work, and nooks for individual activity may be provided. Variety, informality, movement, and the availability of learning resources are other characteristics. A traditional classroom in which desks are provided for students and arranged in rows facing the teacher's desk has a different function: the traditional arrangement facilitates student listening and sedentary work; the teacher is the focus of attention and can direct and supervise student work with ease. The open arrangement facilitates student activity, exploration and interaction.

It is the purpose of this Unit to provide some guidelines for persons planning spaces for learning. It will examine general learning spaces (those which do not require special equipment or effects), spaces for programs with special requirements (such as fine arts, science, physical education), and spaces which support the total educational program (such as the library/media center). The Unit will also consider requirements for the education of exceptional students and young children. Discussion of learning spaces will be limited to indoor facilities. For information about outdoor learning spaces, see the "Site Development" section of Unit F.

Because each educational program has unique facility requirements, it should be recognized that this Unit cannot provide complete or universally applicable information about learning spaces. It does attempt, however, to promote an awareness of possible facility needs and physical solutions to some basic and obvious program requirements.

General Considerations

Classrooms, whether they be open or enclosed, large or small, laboratories, studios or lecture halls should support the educational program in a practical way by providing the space and the types and

quantities of equipment needed. They should provide the required thermal and acoustical environments. They should be properly illuminated. They should respond well to the types of learning activities planned and they should be versatile - able to accommodate various learning situations if necessary.

Before learning spaces can be planned effectively, the educational program outline of planned learning activities and educational objectives should be examined. Each type of learning activity imposes different demands on learning spaces. For example, learning spaces in which teacher-directed experiences are predominant should be designed to permit clear viewing and hearing of the instructor and visual material.

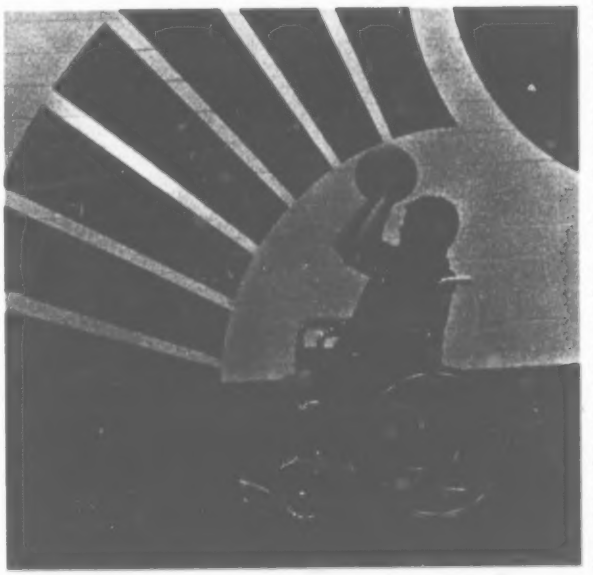
Spaces for group interaction should be arranged to facilitate an exchange of ideas and allow individuals to confront other members of the interaction group. Group activities should not have to contest with outside interference. Access to needed equipment and materials such as chalkboards should be provided. Where independent, self-directed student work is to be accommodated, spaces for individual work, reading, analysis, collection of information and writing — all of which require some degree of quiet and solitude — should be planned. Spaces for experiential, learning-by-doing, programs geared to both individuals and groups require specialized equipment and furnishings. The safety of students and provision of special environmental effects are important considerations.

The planning process is essentially identical for all types of educational environments. It involves identifying the users, describing the learning activities and their desired outcomes, defining the relationship of one learning space to others, describing needed equipment and furnishings, and specifying special environmental considerations. This process is fully detailed in Unit E.

Environments For Special Education

Special education has been developed to handle students who fall conspicuously outside the norm. It has variously embraced persons who are crippled or otherwise health impaired, blind or visually limited, deaf or hard of hearing, language or speech impaired, mentally retarded, brain injured, or developmentally disabled, severely emotionally disturbed or who have emotionally-related learning problems, or combinations of these problems. The Educational Facilities Laboratories, Inc. reports that approximately one child in ten now requires some form of special education. Other sources place the figure as high as fifteen percent.

Culverdale School, Irvine, Calif.; Knowles & LaBonte, Architects



Harris-Hillman School for Handicapped, Nashville, Tenn.; Yeanwood & Johnson, Architects

Thus, the impetus of the court decisions so far is away from secluded restrictive environments exiled from the community, and toward less restrictive, mainstream facilities most like those provided normal children, that is, the least restrictive alternative.

— *Larry Molloy, ONE OUT OF TEN, Educational Facilities Laboratories, 1974.*

Plymouth Elementary School, David M. Crawley Assoc., Architects; photo by Phokion Karas

Madrona Heights School, Port Orchard, Wash., Arnold G. Gangnes & Assoc. Architects; photo by Art Hupy

The differences between regular education and special education do not now appear as distinct as they formerly did. Efforts to improve special education to meet needs of students with conspicuous differences have helped illuminate the essential differences among all students. The blurring of the distinctions between regular education and special education, and the recognition that all students are, in their own ways, different has helped pave the way for the introduction of students with conspicuous differences into the mainstream of education. The judicial system has upheld the rights of all young people to equal treatment, equal education, and equal opportunity. With few exceptions, all students must have the right of access to the mainstream of education and to the process of learning alongside their peers.

Educators and architects alike must keep pace with and anticipate the conceptual, practical, and legal trends in special education and its relationships to regular education. Failing that, they may later face the need to make costly program and facilities changes that with foresight could have been avoided. Educators and architects who simply conform to current minimum standards are likely to be overtaken by the rapid change in the field of special education.

It is certain that there will remain some students whose needs are so highly specialized that they cannot reasonably be accommodated within the mainstream. It is equally certain that there will remain a role for some forms of institutional resources well outside of the educational mainstream which are different in concept and scale from the regular school building. These facilities must be far superior to what they generally are now. The current trend is toward the development of specialized, multi-resource, community-based comprehensive centers. It will probably be years before truly definitive guidelines emerge. Nevertheless, immediate adjustments can be made which will facilitate mainstreaming and equal access. Careful planning is required to eliminate architectural barriers such as steps and curbs, steep and narrow walks, gratings in walkways, narrow doors, small toilet stalls, and drinking fountains and light switches which are out of reach.

Some factors in facility design which assist the students to function safely and with as much mobility as possible are:

- At least one primary building entrance, automatic doors (with pressure sensitive mats and appropriate time-delayed closure) which slide rather than swing open.

- Ramps instead of steps and curbs, both inside and outside buildings.
- Carpeting on floors to reduce slipping and to cushion falls.
- Wide classroom entryways without doors (which permit students free access) but which restrict visual and auditory exposure to the corridors.
- Use of safety glass for doors and accessible windows.
- Avoidance of sharp corners, surfaces, and projections.
- Toilets that are convenient and available, with space and hardware to permit independence.
- Hardware on doors, sinks and cabinets that can be used by all exceptional students and can be quickly identified by the blind.
- Vertically adjustable chalkboards set approximately 18-24 inches away from the wall to permit use by students in wheelchairs.
- Switches, controls, fire alarms, within reach of people in wheelchairs.
- Horizontally mounted railings or grab bars.
- Furniture that can be adjusted vertically and horizontally to meet the needs of individuals or groups of students.
- Specially designed storage spaces to accommodate wheelchairs, walkers, standing tables and other large equipment.
- Raised or recessed signage to identify rooms and spaces.
- Additionally, careful attention must be given to emergency and fire protection systems including easily operated emergency doors, barrier free corridors, and warning signals that are comprehensible to all exceptional students.
- Fire alarms, for example, must be equipped with audio signals for the blind and visual signals for the deaf.

Kenosha Schools, Steenwyk Thrall Architects, diagram courtesy Grand Rapids (Mich.) Public Schools

General Learning Spaces

Spaces for Early Childhood Learning

Richly prepared and varied activity areas are desirable. The spaces should encourage spontaneous, as opposed to highly structured, learning situations and provide for many simultaneous activities involving small groups and individuals. The space will also be utilized for large group activities. Frequently children will require personal space in a corner, loft, or pit.

A well-designed early learning center will provide a warm, textured, homelike atmosphere with many activity-oriented areas for water play, painting, reading, fitting and building, music, dance, creative dramatics, science, animal and plant study. Other

Perhaps more than anything else, youngsters need to make an impact on their environment: to get the feel of it, to mold it, to make it change before their eyes and to master it.

—*Jeannette Galambos Stone, PLAY AND PLAYGROUNDS, © 1970 National Association for the Education of Young Children, Washington, D.C. 20009.*

Stanford Early Learning Center, courtesy Educ. Facilities Laboratories, photo by George S. Zimbel

activities may include nap and eating space, although this is usually not a concern in half-day centers. Surfacing materials should be suitable for the activities of the center, i.e., resilient floors (preferably cushioned) and washable vinyl walls in wet and painting areas. Multi-use areas should be carpeted. Warm, incandescent track lighting or variable intensity and multi-directional lighting provides a more pleasing environment than repetitive, static fluorescent lighting. Ample window areas which allow ventilation are desirable even when the facility is air-conditioned. Windows should be low enough to allow a view to natural outdoor settings. Easy access to outdoor play and learning areas should be provided.

Where parent and teacher training are a part of the early learning center program, an observation room or booths with one-way vision windows is useful. Where an extensive training component is provided, a full classroom accessible from the lobby with one-way vision to learning areas is desirable. This room should be equipped with chalk and tackboard surfaces and projection facilities.

Elementary Schools

In elementary schools, there is generally a heavy emphasis on small group and individual learning in addition to large group activities. General learning areas for twenty-five to thirty pupils may support a variety of activities including group interaction, lectures, reading, writing, demonstrations, and movement. These spaces may accommodate a variety of audiovisual and teaching equipment for both group and individual use. Adequate electrical outlets should be accessible from various locations. Storage and display space for books and a wide range of resource materials are essential. Unless special facilities for art and science are provided elsewhere, the general learning spaces must be equipped to handle these activities in terms of storage and work space. A sink with hot and cold water is useful. Clothes storage facilities, if not located elsewhere in the building, should be provided in the learning space.

An open plan structure which has no interior walls but which may be divided into various learning spaces and activity areas through the use of bookcases, tables, and other furniture can offer great flexibility. It does, however, require special treatment with regard to acoustics — sound absorbing materials on ceiling and walls and carpeting on the floors — and air-conditioning. Provision for storage of materials must be considered. In all spaces designed for young children, scale is an important consideration. The size of the users must be a plan-

Culverdale School, Irvine, Calif., Knowles & LaBonte, Architects

ning factor.

Secondary Schools

Educational programs and spaces which clearly differentiate between types of learning activities and which require specialized environments are more common in secondary than in elementary schools. However, some curricular areas do not make extraordinary demands in the way of equipment and special effects. They must, however, provide a pleasant and functional space for the discussion and analysis of information and ideas. These classrooms should respond to spatial requirements, and should feature appropriate lighting, furnishings, storage, display, and chalkboard area.

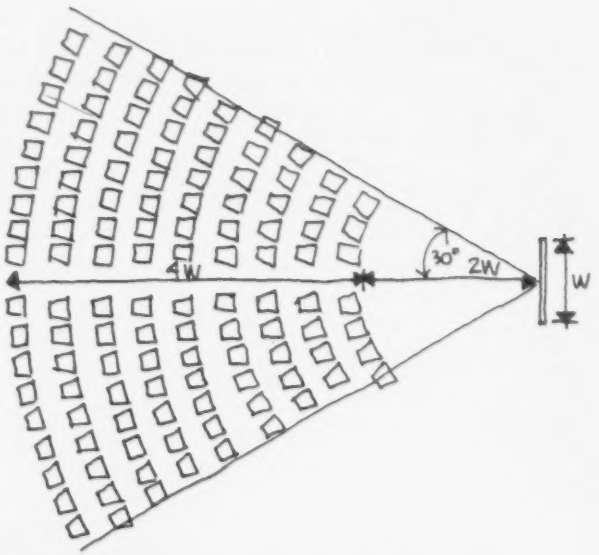
Facilities for Audio Visual Equipment

The frequency with which audio visual equipment is used in the classroom will vary directly with its availability and ease of use. The provision of basic facilities such as a projection screen and adequate outlets in each teaching station will allow frequent and convenient use of instructional machinery.

Two basic guidelines should be employed when installing projection screens. First, no viewers should be closer to the screen than twice the screen width, and no farther away than six times the screen width. Second, all viewers must be seated inside an imaginary thirty degree cone around the projection axis line. These two guidelines, when overlapped, define the four sides of the area in which viewers can be seated. By using these guidelines the facility planner can determine the size screen needed for a given audience space. These guidelines are appropriate for the more popular matte screen surface but will vary for glass beaded, lenticular, and other screen surfaces.

The screen should be positioned so that the surface is perpendicular to the projection axis line. If the surface is not perpendicular, the projected image will be distorted into a keystone shape. In most cases, particularly with the overhead projector, the screen will be at an angle to the wall. Special brackets are available for this purpose.

Adequate electricity is another necessity for successful use of educational media. The equipment, particularly projectors, consumes a large quantity of power. The capacity of a circuit must therefore be adequate for the anticipated equipment. Individualized instruction, involving a dozen or more machines operating in the same space creates a heavy load on electrical circuits. The location of electrical outlets must be planned carefully. The exact locations will be determined by the configurations of the space and the planned program. With the expansion



SEATING GUIDELINES

PROJECTION SCREEN VIEWING

Fodrea Community School, Columbus, Indiana, Caudill Rowlett Scott, Architects

of individualized programs which use media, all classrooms should have electrical outlets every twelve feet along the walls. This spacing will permit individual students and small groups to use the equipment. Without the proper placement of outlets, extension cords which present both a physical and a fire hazard must be used.

The placement of television receivers can be determined using two basic guidelines. First, no viewers should be closer than four times the screen width (not the diagonal) and no further away than twelve times the screen width. Second, all viewers should be seated within an imaginary forty-five degree cone around the axis of the television screen.

With modern construction techniques, the cost of installing wiring after a building is complete is prohibitive. Therefore, adequate empty conduit systems may be installed connecting all teaching stations with a central distribution area. These conduits can be used for the future installation of computer cables, tele-communications wires, or other systems that may be developed during the life of the building.

Harvey Dunn Elementary School, Sioux Falls, S. Dak., Fritzel/Kroeger/Griffin/Berg, Architects

Several environmental factors affect the use of media in schools. Among these are extraneous light control, illumination, ventilation, and acoustics. All windows need some form of light control so that the room can be darkened for media presentations. This control can be full closure blinds, overlapping screens, or drapes. In large open space schools extraneous light from adjacent areas may also need to be controlled by positioning the screen and the audience so that the ambient light falls upon the audience and not the screen.

The illumination within the room or teaching station also needs adequate control. The controls should be easily accessible to the instructor and should allow dimming of particular zones or light groups.

Normal ventilation problems are compounded by the heat produced by equipment. While the heat produced by one piece of equipment is negligible, several slide projectors in carrels will produce considerable heat that must be recycled or exhausted.

The last major environmental factor that must be considered is acoustics. The proper design of the walls, floor and ceiling surfaces will enhance or restrict the transmission of sound. In spaces where large groups of students listen to a single sound source, the room should be designed to direct the sound onto the audience. Areas for individual study should be designed to absorb sound.

Special Learning Spaces

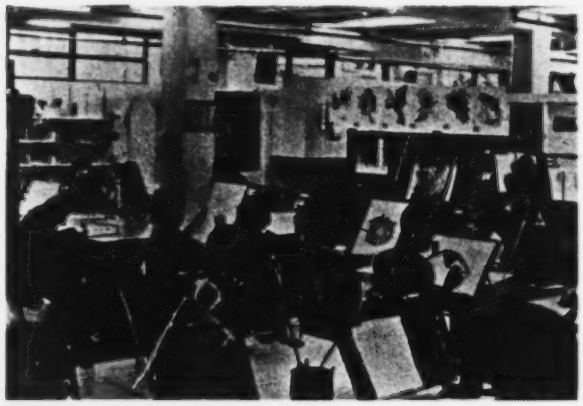
The involvement of the teaching faculty is essential in the development of plans for spaces where experiential learning will occur and where special activities and equipment must be accommodated. Studios, laboratories and specialized spaces for fine arts, music, dramatics, science, physical education, home arts, industrial arts and business education require particular attention to insure that they meet enrollment and programmatic needs.

Fine Arts

In elementary schools, fine arts experiences include painting, drawing, construction, modeling, carving, photography, print making and weaving. The basic media used are finger paints, clay, paper-mache, water color, wood, chalk, tempera, brush and ink, charcoal, pencils, and scrap materials. In secondary schools, activities may include three-dimensional construction projects, graphic arts, mechanical and fine art drawing, modeling, sculpture, ceramics, painting and photography. Some of the important media in use are wax and oil crayons, charcoal, watercolors, tempera, enamels, wood, metal, plastic, textiles, ink, yarns, clay, leather, wire, reed, and raffia.

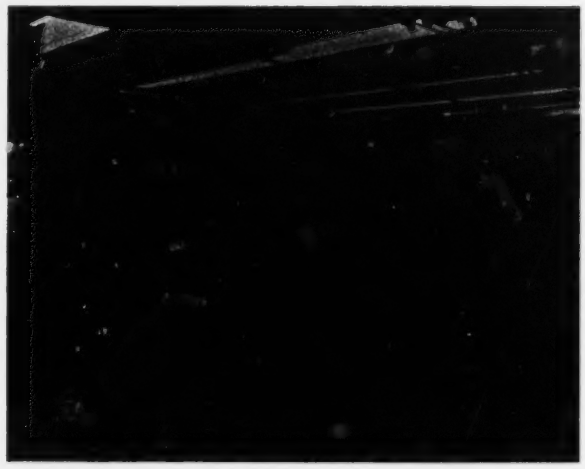
It is advisable to have art learning spaces located on the ground floor with access to related curricular areas and convenient entry for delivery purposes. If the spaces are to be used by adult groups after regular school hours, they should permit easy entry from the outside. During school hours, pupils also need ready access to the out-of-doors for sketching, painting and field trips.

On the elementary level, art activities are best performed on tables with mar-resistant surfaces. Other essential equipment and furnishings include storage cabinets; clay bins; a tool cart with saws, hammers, drills, files, chisels, and easels; workbenches with vises; projectors, screens, and other audio-visual devices and a kiln to be operated by the teacher. In programs designed for older students, activity spaces may be equipped with movable tables and stools, one or more clay and enamel kilns, jigsaws, drill presses, grinders, buffers, workbenches, drafting tables, easels, metal covered counters, craft tables, clay trapping floor drains, drying racks, hooded spray booths, plaster of paris bins, an oven for plastics, a printing press, paper cutters, sewing machines, chalkboards, tackboards, projectors, screens and other audio-visual devices. These items may be found in several art rooms, but no room would probably require — or could accommodate — all of them.

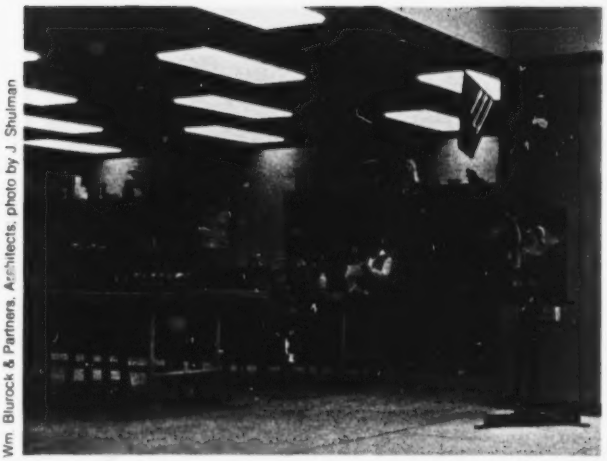


Crow Island School, Winnetka, Ill.; Perkins & Will, Architects and Curtis-Smith Associates; photo by Steve Kaul

Sierra Elementary School, Jefferson County, Colo.; Rogers-Nagel-Langhart, Architects



Crow Island School, Winnetka, Ill.; Perkins & Will, Architects and Curtis-Smith Associates



Estancia H.S., Costa Mesa, Calif.
Wm. Blurock & Partners, Architects, photo by J. Shulman

Electrical outlets need to be accessible from many places in the art learning spaces. Some stationary equipment should be directly connected to electricity. Several of the spaces also need large, deep, acid-resistant sinks surrounded by built-in cabinets. Sinks should have traps and drainboards or built-in drying racks.

Illumination which is glare free, intense enough for detailed work and which allows true color discrimination is vital. Natural light from northern windows is ideal.

When photography is included in the creative arts programs, a darkroom will be needed if the program is more than elementary. Darkroom equipment should include good light control devices, possibly a light-tight door, a sink with hot and cold water, workcounters, general storage, light-proof storage, and the necessary developing, enlarging and printing equipment.

Spaces for learning experiences in drafting need to be provided for both group instruction and individual work. Special consideration should be given to the lighting conditions in the space. Storage should be designed for wide materials, and shelves in cabinets should be adjustable. Built-in racks for books and magazines may also be provided.

Estancia H.S., Costa Mesa, Calif., Wm. Blurock & Partners, Architects, photo by J. Shulman

Paints, acids, cleaners, and other inflammable or combustible items should be stored in locked, metal cabinets. Perforated pressboard with hanging devices are useful for storing tools. Large, flat, easily manipulated drawers for oversize watercolor paper and poster board enable easy access and proper storage of materials. Storage of partially completed projects may be on shelves in the art room or in an adjacent room. Locked drawers designed to function as tote trays, or with tote trays in the interior, should be provided for the storage of jewelry, leather, and expensive and delicate materials and tools.

Deep display cases should be built as part of the walls separating art spaces within the building. They should have adjustable shelves for three dimensional objects, an electric outlet, and tackable sides and back. Other cases for displaying pupils' work can be exhibited near entryways of auditoriums, cafeterias, commons and other public areas.

Many types of floor finishes are not satisfactory for art rooms. Close-grained hardwood, such as good quality maple, makes a sturdy art room floor which can be refinished easily. Maple, if well finished, does not absorb odors and stain readily. Light-colored rubber asphalt, vinyl asbestos, or vinyl tile are all light reflecting, easily maintained, and less fatiguing than stone or concrete although treated concrete

floors may be considered for metal sculpture areas. Patterned tile shows soil or stain less readily than solid colors.

Art teachers must have ample work space and in some schools, art workrooms for teachers are separated from the student art areas. In smaller schools, this area may be incorporated within a supply and storage room.

Dramatics

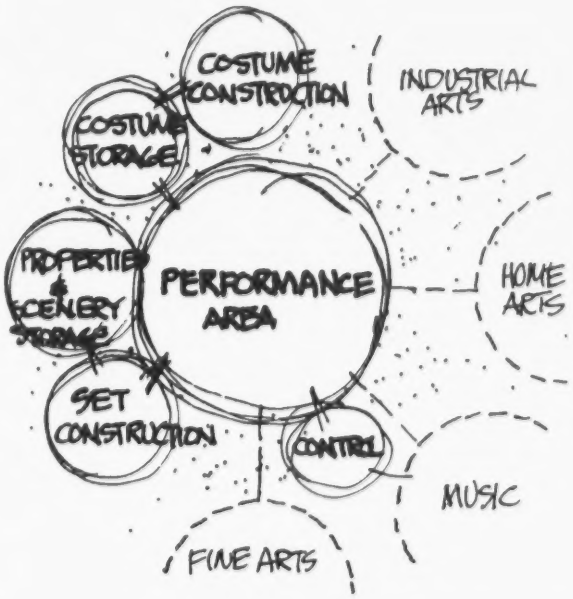
The conventional school auditorium which is used for lectures, vocal and instrumental concerts, pep rallies, commencement exercises as well as numerous other school and community activities is normally inappropriate for dramatic productions. Generally these facilities lack proper lighting capabilities, enough backstage area, good theatrical acoustics, an intimate performer-audience relationship, and dressing room, storage and construction space. Because theatre has very specialized spatial and physical requirements, any school which operates a serious dramatics program should consider a separate environment for its activities. Experimental or laboratory theatres are ideal for this purpose.

Actually, a suitable space for dramatics can be provided in a large, relatively unfinished room which functions as an instructional, rehearsal, and performance area as well as a workshop for scene construction and painting. This space may be located near the auditorium to take advantage of existing lobby facilities (ticket sales, toilets) and other audience services (parking space). Any space to which easy access can be provided is suitable. Proximity to industrial arts, home arts, music and fine arts areas may be desirable if a working relationship with these programs can be established. Unfortunately such cooperation is often difficult to maintain due to dissimilarity of procedures and goals.

A laboratory theatre should possess the following features:

- A wood floor — tile and concrete are inappropriate — of 2" x 6" yellow pine, tongue and groove, set on sleepers to allow give. A wood floor is imperative since scenery and equipment must be fastened into the surface.
- A large work sink with heavy duty plumbing and removable trap should be located in the section to be used for scene construction and painting.
- Adequate circuitry and electrical outlets are essential. Normal 110 volt circuitry is sufficient unless bench type equipment is to be used. Ordinarily, basic set construction can be accomplished with hand and hand-held power tools.

Austin (Texas) High School; Barnes [illegible]des Goodman Youngblood, Architects



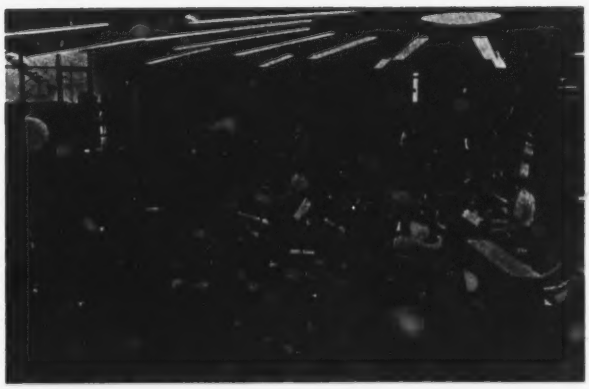
SPATIAL RELATIONSHIPS
LABORATORY THEATRE

- Installation of special wiring for theatrical lighting will require the advice of a theatrical lighting consultant. These persons can be identified through university theatre departments, United Scenic Artists' offices in New York, Chicago and Los Angeles, or the consultant referral service of the U.S. Institute for Theatre Technology.
- Space and equipment for costume construction are necessary if a cooperative arrangement cannot be negotiated with the home arts department. Costume construction requires at least work tables, sewing machines and ironing facilities. Costume storage should be humidity controlled to prevent dry rot and mildew.
- Storage space for properties and scenery should be provided.
- Storage for tools and hardware, paint, glue and so on should be conveniently located near the set construction area.
- A pipe grid or catwalk system for lighting should be installed.
- A control booth for light and sound which is sound-isolated may be a separate room with a window on the performance space or located on a peripheral cat walk.
- Audience seating (75-150 capacity is appropriate) can be provided on collapsible risers and portable chairs which can be moved around to satisfy a variety of production situations. Pull-out risers can also be used but they are inflexible.

In general all of the above requirements involve a larger investment for equipment than for the structure itself. Educational theatre needs a workshop, not an elaborate auditorium. Laboratory theatres should be functional. They should allow experimentation with acting, directing and technical aspects of theatre. An informal, but suitably equipped, multipurpose space like the one suggested above will serve well and economically as a learning area. Numerous other laboratory theatre designs are possible. For more information, see *Theatres And Auditoriums* by Burris-Meyer & Cole.

Music

Physical and spatial requirements for music education obviously exceed the capacity of the conventional classroom. Spaces for individual and group, vocal and instrumental instruction and rehearsal are usually necessary. The size, quality and number of these spaces will be determined by the enrollment and the educational level of the school, the scope and sophistication of the music program, and by the encouragement offered music education by the administration and the community.



Horton Watkins Senior H.S.,
St. Louis, Mo.: Wm. B. Ittner, Architect

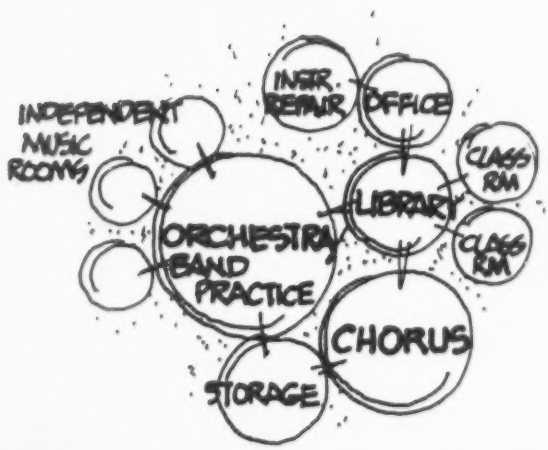
The following spaces may be required by the music education program:

- Teaching spaces for instrumental and vocal instruction on an individual and group basis. The size of these spaces will depend on enrollment and organization of classes, educational goals, and required equipment.
- Classrooms for teaching music theory, history, etc.
- Rehearsal rooms for individuals and small groups. Acoustic treatment of these spaces is critical.
- Offices for the faculty and staff, some of which may double as studios.
- Library for recordings, tapes and sheet music. Space and equipment for sorting and cataloging should be considered. The size of the area will be determined by the size of present holdings and the acquisition/elimination policies of the department.
- Listening area equipped for the playing of records and tapes.
- Storage areas to accommodate musical instruments, teaching aids, uniforms, music stands, risers, shells, lights, and other performance apparatus. These should be located close to areas where equipment will be used.
- Secure storage space for privately owned instruments.
- Performance area which may be shared with other departments or designed specifically for the use by the music department. (Auditoriums will be discussed in Unit H, "Auxiliary Spaces.")
- Facilities for recording, instrument repair and an experimental music studio are other possibilities.

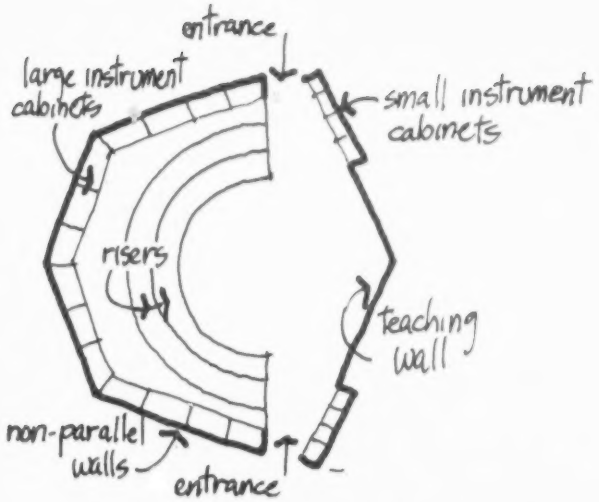
Design considerations related to music education facilities involve careful attention to acoustics, room size, shape, temperature, relative humidity and spatial relationships.

Acoustics are obviously critical and often a consultant can be helpful in designing spaces which will enhance the quality of sound. Surface materials which eliminate distortions and undesirable transmissions of sound can be applied. Windows, doors, walls and floors should be treated so that transmission of sounds to and from other areas is reduced. Air ducts should be acoustically lined. Noisy HVAC equipment should be located away from music facilities. Corridors, storage areas and other non-learning spaces can be used as buffers to prevent aural distractions.

The shape of rooms for group vocal and instrumental instruction affects the quality of sound. Trapezoidal rooms are optimal, both from an aural and visual



SPATIAL RELATIONSHIPS
MUSIC



INSTRUMENT REHEARSAL

standpoint. Ceilings should be higher than those in standard classrooms, usually 14' to 18' feet. If risers are built in, they should be carefully designed because of their inflexibility. Although rooms for vocal and instrumental instruction have different requirements, they may be combined if necessary but not to the full advantage of either use.

The thermal environment of both instructional, practice, and storage areas is important. Fluctuating temperatures and low humidity are detrimental to musical instruments, wooden ones in particular. Therefore, a constant temperature from 64° to 73° should be maintained. Relative humidity of 40% to 50% is acceptable.

The efficiency of the music complex will depend on spatial interrelationships and the relationship of the complex to the other facilities within the school building. Public access and proximity to a loading dock (to allow movement of equipment), to dramatics, visual arts and the performance areas are advantageous. Educational efficiency is promoted by grouping spaces within the complex that are functionally related, i.e. the music library and listening areas or practice rooms and instructional areas.

Proper illumination is an important consideration; lighting should be intense enough so that musicians can read music which is farther away than normal reading material. Electrical outlets should be located where needed. Ventilation is obviously important here as in all other learning spaces. Security of school and privately owned equipment should be considered.

Dance

Although dance programs often have the misfortune of being under the auspices of the physical education program where they almost always suffer financially and artistically, their physical and spatial needs should be considered separately or in conjunction with other arts areas like drama and music. Dance programs have specific environmental requirements which are rather inflexible. Instructional and rehearsal space for dance requires hardwood flooring which is properly installed on sleepers, not laid on top of concrete, or any surface which will not give. Rigid flooring can cause leg injury. One wall of the dance studio should be mirrored with provision for covering. An exercise bar should be installed. Good ventilation is essential. The thermal environment should be warm to prevent muscle strain. Storage space should be provided for costuming, rhythm instruments, records and tapes. Electrical outlets for record and tape players are essential. Dressing room space should be available to dancers either exclusively or on a shared basis.

The rehearsal/instruction area described above could be used for dramatics provided that the floor is protected. The dramatics performance area described earlier may be used for dance if a portable dance floor is installed. The large multi-purpose auditorium is usually impractical for dance performance primarily because of the inadequacy of floor surface and lighting.

Science

Science laboratories may be incorporated into general classroom spaces, may be multiple-purpose to serve different science programs, or may be designed for specific courses. The specialization and sophistication of these facilities will depend largely on the size and resources of the school. This section will consider both general and specialized lab spaces.

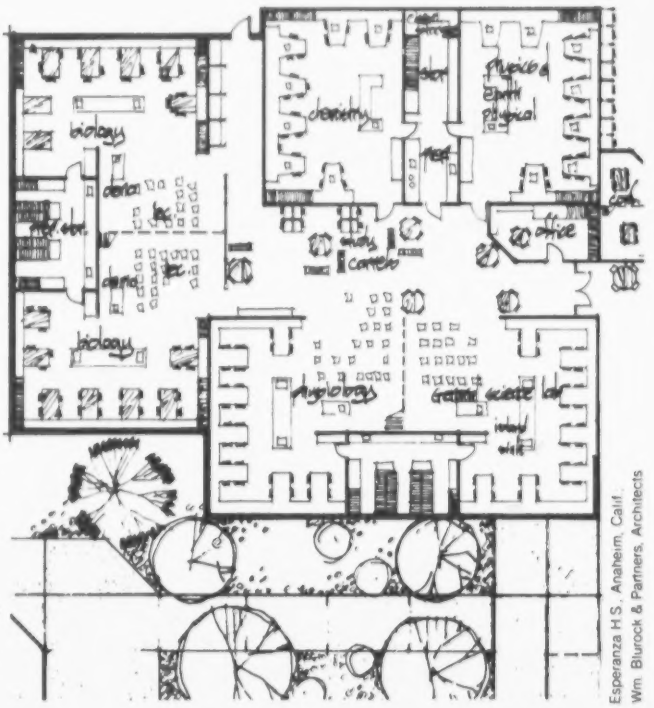
General laboratory spaces: Combination lab/general learning areas require space for lecture, use of audio-visual devices, individual and group project work, demonstrations, and group discussion. Flexibility within the area to meet the needs of different activities can be achieved by locating base counters and wall cabinets on the periphery of the room with the central area left open for lecture purposes. Adequate sinks, hot and cold water, gas, air or vacuum (if needed), and electrical outlets should be provided based on class size during the anticipated enrollment peak. Chairs and tables may be best for student seating because of their flexibility. If the work counter and student tables are the same height, the need for separate seating for lecture and lab work is eliminated — an advantage in terms of space and cost.

The furniture and equipment to be accommodated within general science lab areas are a demonstration desk with all utilities, adequate chalkboard and tackboard space, adjustable shelving for reading-reference center with appropriate tables and chairs, plenty of storage space, low voltage direct current (if needed), portable aquariums, terrariums, etc. and two and three dimensional display units. Display area visible from corridors may be desirable.

Provision should be made for storage of all types of equipment, instructional supplies, learning aids, individual student or teacher experimental work. Work counter space for preparation of demonstrations should also be considered.

Movable labs with plumbing which can be transported to different locations within the room contribute to flexibility although they are expensive. The movable lab is beneficial in small secondary schools with 600-800 student enrollments where multi-purpose laboratories are essential.

Gallatin (Tenn) High School. Yearwood & Johnson, Architects.



Esperanza H.S., Anaheim, Calif.
Wm. Blurock & Partners, Architects

Photo courtesy K M Associates

Gallatin (Tenn) High School. Yearwood & Johnson, Architects

Multi-purpose labs can also be achieved by planning (1) one-way facing tables with a demonstration desk in the front of the room and the entire room being used for all activities, (2) separate areas at opposite ends of the laboratory for demonstration-discussion and laboratory activities, and (3) a perimeter arrangement of tables and work counters along two or three walls with a demonstration/desk and pupil tables along another wall, and research and other related activities grouped elsewhere.

Most schools have sufficient students enrolled in separate courses for full utilization of separate action learning laboratories for biology, chemistry and physics. General learning spaces for demonstrations, lectures and discussion may be shared or separate.

Biology: The overall design of a biology lab should include wall and floor surfaces planned for effective housekeeping. Floors, tables, worktops and counters should be resistant to water and warpage and easily cleaned, especially in areas where plants and animals, supplies and equipment are kept. Many activities such as dissection require more than general illumination. Auxiliary lighting may also be required for such special spaces as growing areas. Areas where animals are kept need to be fully ventilated.

Refrigerators, pressure cookers, autoclaves, units for cooking and drying such as a kitchen range, incubators, portable AC/DC power supply units, centrifuge, or a fume hood are some major items of equipment which may need to be accommodated.

If space for raising and experimenting with terrestrial and aquatic animals and plants are planned, they will require environmental controls for humidity, ventilation and heat independent from the building's main system so that proper conditions can be maintained when the central system is not operative. Durable materials, water supply, and floor drains, should be considered in designing this area.

Access to outdoor learning areas is an important consideration. Outdoor spaces should be surfaced, have storage and work areas and some form of overhead shelter.

Chemistry: Arrangement and equipping of the chemistry laboratory will depend on the educational program and required flexibility. Generally, laboratory desks should have sinks, hot/cold water, gas, electrical outlets, compressed air and vacuum (if needed), shelves, storage drawers, and cabinets. Tops of all work surfaces should be appropriate for planned use. Stone, resin, colorlith, soapstone, and pressboard are possible materials. Gas and adequate circuitry and electrical outlets should be

available at various places in the lab. Portable power packs may be used to convert AC power to DC power. Each student should have a lockable space at the lab station for storage of frequently used hardware such as test tubes and beakers. Storage space may also be needed for students' personal paraphernalia — books, briefcases, and clothing.

A wall sink with double drain boards and storage counter below may be needed in the main lab depending on the number and size of sinks provided at student work centers and in the storage and/or preparation room(s).

Bulletin board and chalkboard space should be provided in the chemistry lab for display and lecture use. Shelving for equipment, models, and charts will be needed. Some storage units may serve dually as display space. Good lighting, electrical outlets, and possibly a water supply and drainage may be provided in the display area.

Storage for chemicals and apparatus may be located in a separate room although stored items should be readily accessible. Some chemicals should be stored in locked cabinets. (Cabinets for storing chemicals must resist corrosion and may require ventilation). The storage area and preparation room may be conveniently combined. A refrigerator may be needed.

Other equipment requirements for chemistry labs include fire extinguishers, blankets, emergency showers or eyewash fountains, and first aid supplies and equipment. Master controls for utilities should be placed at a convenient central location. Wheeled equipment carts of acid resistant materials for transporting equipment and supplies and for use as distribution centers should be accommodated. Fume hoods are also required to remove toxic gases from the chemistry lab.

Physics: The following are basic physical and spatial requirements for a physics laboratory: (1) laboratory equipment and student storage space; (2) portable compressed air and vacuum systems at demonstration stations and at various other locations throughout the physics space; (3) controlled light area for experiments with optics and for certain kinds of photographic work; (4) both alternating and variable voltage direct current both at the instructor's desk and at various points throughout the physics area; (5) a small workshop for student and teacher preparation and for small group work.

Space is needed for teacher preparation as well as storage for supplies, equipment, projects, and instructional and learning materials. Developmental, research, and special project activities may need to be accommodated. Preparation room adjacent to

Senior H.S., Emporia, Kansas, Horst-Temill & Karst, Architects

Whitney Young High School, Chicago, Perkins & Will, Architects

the physics lab or adjoining two labs should include a sink equipped with preparation table with hot and cold water, gas and electricity.

An equipment truck, teacher's desk, filing space, research facilities and a work bench may also need to be accommodated.

Shelving and cabinets for storage and distribution of supplies, equipment and apparatus usually not kept in the physics lab should accommodate items of various sizes and shapes. Accessibility should be considered in planning.

Spaces for teachers and interested students to work on individual or group projects may also be required in a physics lab. Careful assessment of the number of students who will engage in such a program and the activities undertaken are necessary in planning these spaces.

Astronomy, meteorology and geology are other sciences that may be included in secondary school programs. If so, the extent to which these curricular areas can utilize the laboratory spaces described above or, if funding and interest are substantial, the desirability of planning special facilities will have to be assessed.

Physical Education, Athletics & Recreation

Indoor facilities for physical education, athletics and recreation are difficult to discuss because of the wide range of variables affecting their development. The educational program, the school's involvement in competitive and spectator athletics, the relationship to community recreational programs and facilities, available funding, the size of the school, the age of the students and the climate are some important factors affecting the nature of a school's physical education facilities. In spite of these variables, there are nevertheless a few generalized recommendations which should be useful to planners.

As with other program areas, it is essential that the physical education staff be involved in the planning of the facility, that the program be fully outlined, and that its requirements in terms of space and equipment be clearly understood. Due to the difficulty and cost of expanding physical education facilities, requirements for both immediate and long-range use should be considered during the initial planning stages. Possibilities for cooperation in the development and use of the facility should be investigated with interested agencies and groups. Economy of operation, particularly with regard to energy use, is another critical concern. Fuel conservation may have to be reconciled with extended use of the facility.

Other current needs affecting spaces for physical

Kemsville Elementary School, Whitehall Tnshp, Penn.; Breslin, Ridyard, Fadero, Architects

education, athletics and recreation deal with provision of equal facilities for women and men, facilities suitable for handicapped persons, facilities for participatory and lifetime sports and facilities which are flexible and can be used for a variety of activities.

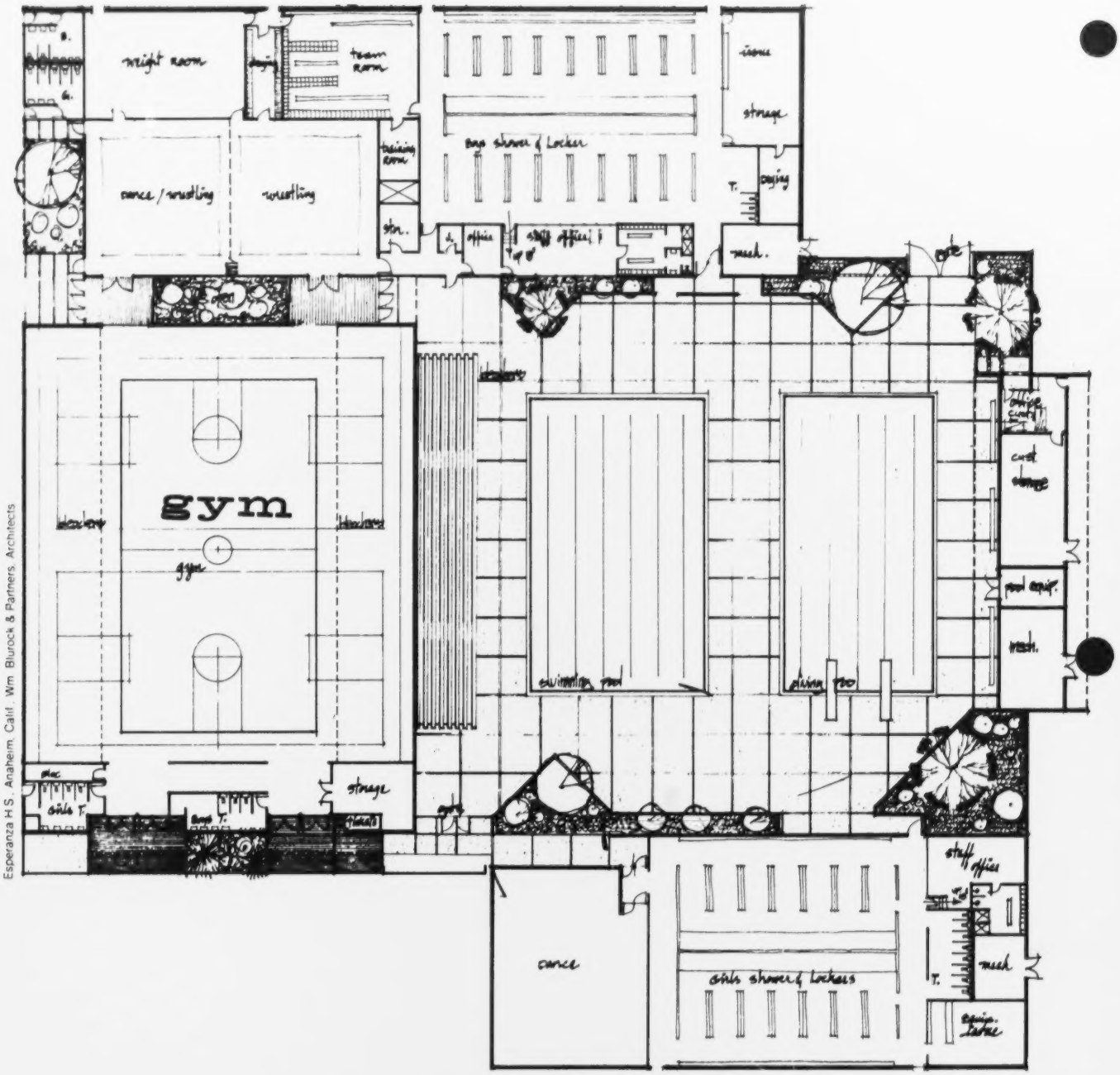
The size and layout of the physical education facility will depend on the type of the school and the program to be implemented. Obviously, elementary and secondary schools do not have the same needs. Generally, elementary school gymnasiums are smaller and do not require extensive dressing rooms, storage and office space. Occasionally the elementary school gymnasium may be planned to serve a dual function as a cafeteria during part of the school day. However, some of the guidelines for larger, more complex secondary school facilities are applicable to these spaces.

Factors to be considered in planning facilities for physical education, recreation and athletics are:

- Physical education facilities should be isolated from classrooms where noise would be distracting.
- Space and area relationships should be carefully analyzed.
- Number of needed teaching stations should be determined.
- Traffic patterns of students, other users, and spectators should be examined.
- Safety of users is a vital concern. Non-slip floors and non-abrasive wall surfaces should be provided. No sharp edges and corners should be exposed.
- Attention should be paid to durability of materials used on surfaces and furnishings.
- Low-cost maintenance is an important consideration.
- Electrical outlets should be provided where needed.
- Proper acoustics are vital to reduce noise, reverberation and echo.
- Ventilation needs in main facility and auxillary areas should be examined.
- Lighting will require special attention to insure installation of suitable fixtures which are recessed or shielded and adequate in terms of quality and area of illumination.
- Windows in gymnasiums should be elevated and protected.
- Communications systems should be considered if needed.
- Entrances/exits should be located with regard for traffic flow; doors should swing out and should be flush with the floor.
- Special arrangements for fixed equipment (i.e. basketball backstops) and suspended apparatus for gymnastics should be considered.

Thomas Jefferson Jr. H.S. and Community Center; Vosbeck-Vosbeck-Kendrick-Redinger, Architects

- Facilities for emergency first aid should be provided.
- Offices for staff should be conveniently located.
- The location of indoor areas (dressing, showers, etc.) should be accessible from outdoor recreational areas and playing fields. The interrelationships of indoor and outdoor facilities should be carefully considered during planning.
- Locker areas and dressing rooms should be adequate for the numbers and size of the users.
- If floors are to be flushed, they should be sloped and equipped with drain holes along the perimeter of the room.
- Floors of locker, shower and drying rooms should be surfaced with non-slip ceramic; tile-bare concrete is not recommended.
- Drinking fountains (usually recessed) should be provided in locker areas.
- Storage areas for equipment should be adequate in size, conveniently located, and accessible to play areas.
- Outside storage accessible from outdoor playing fields should be considered.
- Hallways, ramps, and doors without thresholds and upright central supports should allow movement of equipment.
- Attention should be paid to security of storage areas.
- If space is to be used for spectator sports, provisions for the spectators (such as seating, toilets, ticket purchase, access to build-



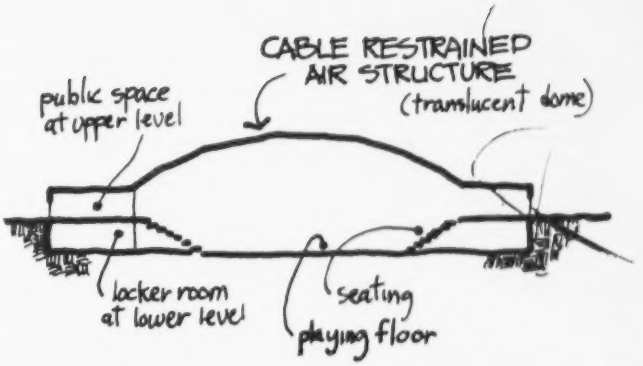
ings and parking) will have to be studied.

- Accessibility from main entrance and parking areas should be considered.

It is possible to design a physical education facility to accommodate a variety of activities. Options increase with the size of the space. Modules measuring 60' x 120' can handle basketball, tennis, volleyball or badminton as well as other activities. The use of several modules provides even greater flexibility. Spaces can be divided with folding partitions or with roll-down nets with or without opaque screens. Synthetic flooring surfaces which have a variety of floor markings make transitions in use possible. Floor sockets allow easy conversion to sports requiring nets. Wood flooring, while it has definite merits, is expensive and impractical for large expanses. Also, the permanence of markings may discourage multiple use.

Major activity spaces usually involve a large open span which must be covered. When conventional structural techniques are too heavy and expensive, lightweight non-rigid coverings can be employed. These are available in a variety of heavy duty, fireproof fabrics with long-life capacity. The material can be fabricated in layers to create air pockets for insulation. Because it is translucent, artificial illumination is not required during daylight hours. Air supported fabric structures are relatively inexpensive, are available in a variety of shapes and sizes, and are demountable. Tent structures also can be used for roofing large spans. These new products and methods increase the possibilities for multipurpose physical education facilities and allow the realization of a wide range of building plans.

Activities which, because of their specialized nature, cannot utilize the main facility, will require separate spaces. An example of these is handball which requires a specially designed court. The physical and spatial needs of such activities must be investigated. Another possible component for a school physical education/athletics/recreation facility is a swimming pool, the size, type and quality of which will depend on intended use — competition, diving, instruction, recreation and so on.

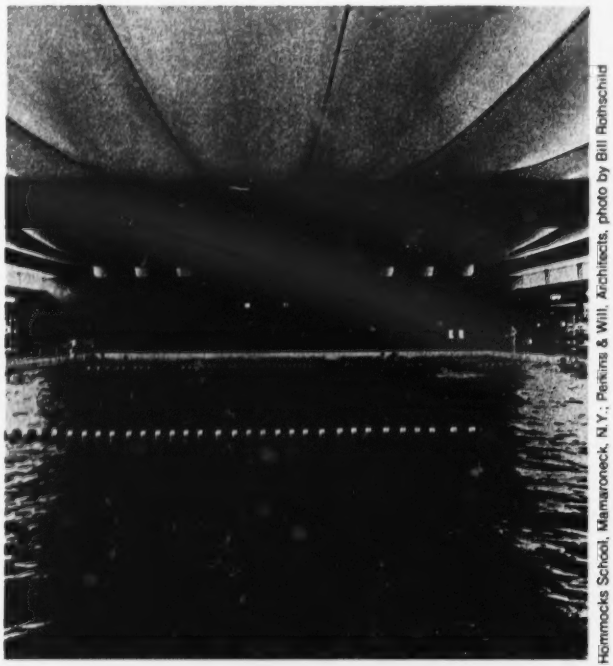


AIR SUPPORTED FABRIC STRUCTURE

Distributive Education

There is no consistency in the assignment of distributive education to a curricular area: some schools associate the program with home arts; elsewhere it is treated as an aspect of business education. Whatever its programmatic affiliation distributive education has some specific spatial and physical requirements which should be accommodated. The room should be large enough to accommodate tables rather than desks for student seating and work. Large, flat surfaces are necessary. Ample storage space — maybe even an additional room with cabinets and shelving — is important. Storage space is needed for display props and other marketing/merchandising supplies. Display counters are needed as well as an illuminated window display case facing a corridor. A sink with hot and cold water may be required. Office space for the instructor should be provided.

Distributive education spaces may be located near the main entrance of the school to allow easy delivery of supplies and access to class visitors. Sound isolation is not as important for this area as it is for some others.



Hommocks School, Mamaroneck, N.Y.; Perkins & Will, Architects, photo by Bill Rothschild

Westminster (Colorado) Career Enrichment Park; Wm. Blurock & Partners, Architects

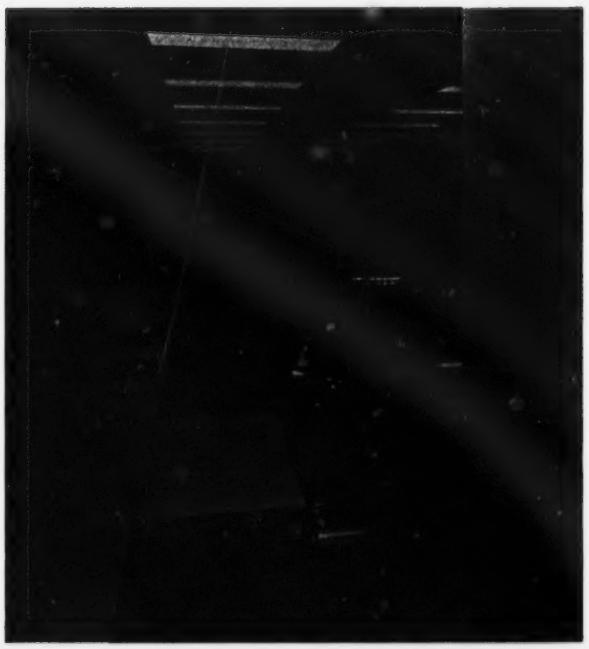
Business Education

Spaces for business education, whether they are distinct learning areas within a common space or

Kent Skills Center, Grand Rapids, Mich.; Daverman Associates, Architects

separate rooms, usually accommodate instruction in and experience with typing, office procedures, bookkeeping and accounting, and use of general business machines, adding machines, calculators, duplicating equipment. The character and design of business education spaces will depend on the nature of the instructional program, the number of students involved, and resources of the school.

Special environmental requirements are underfloor electrical circuitry in rooms where typing, bookkeeping and shorthand will be taught and practiced. Adequate circuitry with both floor and wall outlets are essential for convenient placement of all business machines. A master control switch is useful in these areas. Ceilings should be acoustically treated. Carpeting may be considered as a covering in typing and other areas. Chalkboard installation will depend on the use of the room. For instance, a typing room will require little chalkboard space, whereas the room in which bookkeeping/accounting is studied should be furnished with chalkboards. Cabinets, shelving, and closets for storage should be determined in advance and built in appropriate quantity. Lighting should be standard. The arrangement of the typing room should be such that natural light entering through windows is to the typists' right, illuminating copied material. In an area where duplicating machines are being used, there should be a sink with hot and cold water. Work counters are important. Space should be large enough to accommodate persons, machinery and furniture and to allow easy traffic flow.



Paul V. Moore H.S., Central Square, N.Y.; Sargent-Webster-Crenshaw & Folley, Architects

Home Arts

In most institutions the home arts program focuses on human beings and their home environments in an attempt to aid students in acquiring the skills that will enable them to establish a successful home life and to pursue a vocation.

The learning center for home arts requires several learning spaces which are equipped to meet diverse educational objectives. To minimize problems of delivery service, waste removal, and adult and student traffic, a first floor location is advantageous. The amount and size of equipment used and the number of students to be accommodated will determine size of the space. In addition to a general learning area for lecture and discussion, specialized areas for experiences in child development, home furnishings, foods and nutrition, clothing and textiles, and family health may be required.

A space for teaching child development may be structured as a play school for young children. If a nursery school is an ongoing part of the school's educational program, accessibility to classes in

home economics may be desirable. Easy storage of equipment should be planned. Safe and comfortable indoor and outdoor space should be designed for groups of six to ten small children and an equal number of home arts students. Accessibility to toilet and wash basin facilities suitable for small children is necessary. Space to seat observers (that part of the class not actively participating in the program) is desirable. Space for ten to fifteen observers behind a one-way screen is useful.

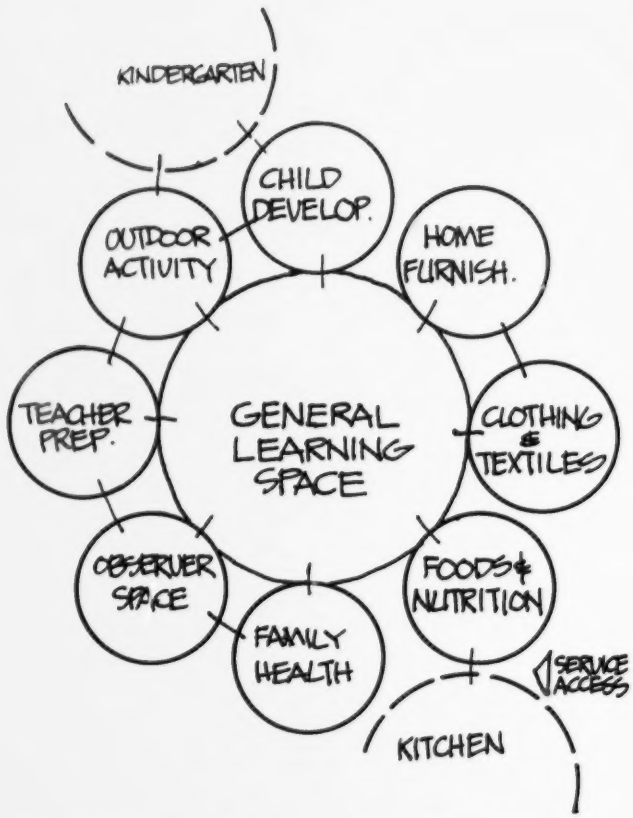
A center for learning about housing and home furnishings should be large enough to simulate living conditions desired by the community. Space should be provided for demonstration and laboratory activities involving the operation of and experimentation with household equipment such as sweepers, floor polishers, washers, dryers, and other electrical appliances. Convenient access to the kitchen area is necessary where electrical appliances, cleaning supplies, household fabrics, and other items may be tested by individuals or by small groups. Tables, chairs, book shelves, beds, couches, lamps, flower containers, household textiles and other equipment used in the study of home furnishings should be accommodated if used.

Spatial, equipment, and mechanical needs for the study of food and nutrition may include unit kitchens typical of those found in the community, work space with durable surfaces, portable or stationary appliances, cabinets with adjustable shelves and dividers, electrical outlets and gas connections suitable for appliances, hot and cold water connections for sinks, and ventilation hoods.

Instruction in and experience with clothing and textiles will probably require space and equipment for cutting, sewing, fitting, storing, and other activities related to clothing selection, care, repair, design and construction. Possible facilities needs are: (1) space and seating for groups at tables with plenty of room for clothing construction; (2) folding tables and portable cutting boards; (3) portable and/or stationary sewing machines and convenient electrical outlets; (4) storage space for garments, accessories, and clothing exhibits; (5) fitting room with adjustable mirrors; (6) access to laundry equipment; (7) pressing and ironing equipment.

Space for instruction in family health should accommodate facilities for testing home sanitation methods and for solving problems related to family health. Storage space and a model family medicine cabinet may need to be accommodated.

Finally, a space may be needed for teachers' use in preparing instructional materials, conferring with students, and storing student records and reports.



SPATIAL RELATIONSHIPS

HOME ARTS

Venado Middle School, Irvine, Calif.; Wm. Blurock & Partners, Architects

G-23

Multiple purpose learning spaces may be desirable or essential and are not difficult to arrange. For instance, a space for family living can be utilized for teaching housing, home furnishings, care of a convalescent in the home, child development, home management, and family relations. Projectors for visual aids, mobile units, convenient storage and uncommitted floor space will increase flexibility. A space designed for the study of foods and nutrition will probably not be as flexible as some other spaces because of the need for large, heavy equipment, but, by limiting the number of such pieces and by locating all non-mobile equipment around the wall, some flexibility is possible because the main floor space is clear.

Tile floors are suitable in home arts complexes or rooms although carpeting may be preferable in certain areas. Wall finishes should be easy to clean. Acoustics should be carefully designed.

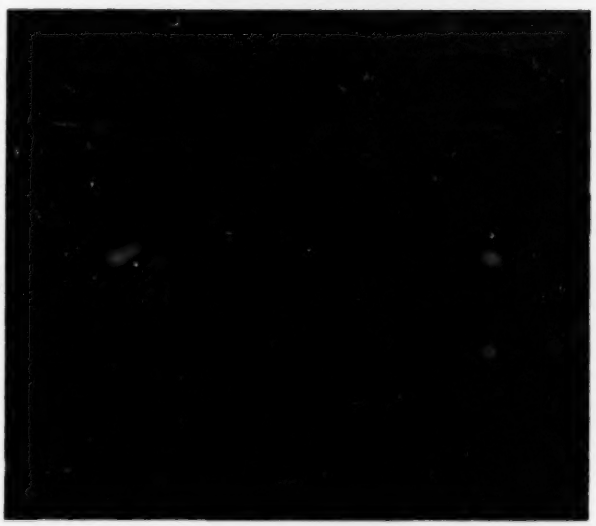
Industrial Arts

An industrial arts lab may include spaces for work with wood, metal, plastics, electricity, and drafting. The space should be arranged to allow convenient sharing of equipment where appropriate. Effective design is also achieved by clustering clean, quiet areas, clean but noisy areas, and dirty, noisy areas to avoid conflict and disturbance. Shops should be located on the building's grade level with a service entrance to allow delivery of supplies and to enable the development and use of outside work and storage areas. Storage space for lumber and other supplies is vital and should be located near the delivery entrance.

Special consideration should be given to the safety of pupils and teachers. Particular attention should be directed toward provision of adequate space for each activity and unobstructed visibility throughout the work area. Equipment should be arranged to isolate machine operators from traffic and to provide adequate aisles between various parts of the shop. Other factors that have bearing on safety include proper painting of floor areas where danger exists, selection of proper floor coverings for various shop activites, and provision of appropriate fire-extinguishing equipment, particularly where spray painting is practiced. Each machine should be equipped with a start-stop breaker switch located within easy emergency reach of the operator. Other emergency switches should be located throughout the room.

It is imperative that electrical, mechanical, plumbing and structural systems be carefully planned and coordinated with the equipment to be utilized. All machinery should be electrically grounded. A venti-

Buerkle Jr. H.S., Mehlville Sch. Dist., St. Louis, Mo.; William B. Ittner, Architect



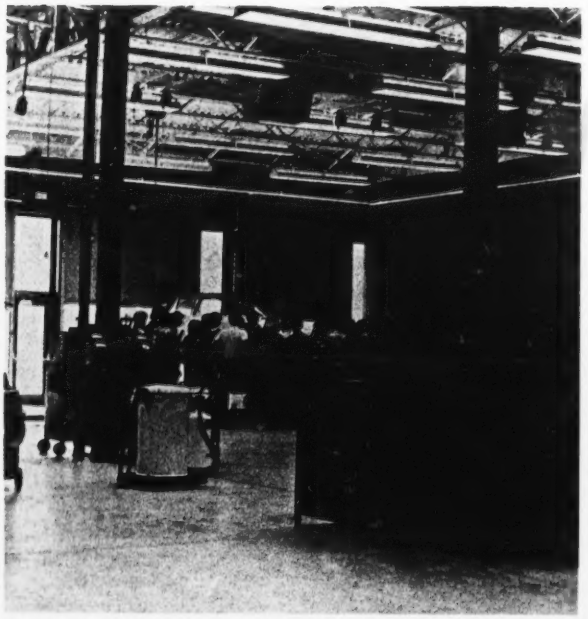
Williamstown (Vt.) Jr. Sr. H.S., Sargent-Webster-Crenshaw & Folley, Architects

lation system is essential for the health and safety of the facility's users. Hoods for exhaust systems should be installed particularly where hot metals, live engines and spray booths or plastics are used. Dust collection systems with flexible suction heads should be installed on woodworking equipment, especially the wood planers, jointers, and belt sanders. Finishing booths for hot metals and painting and automotive shops require ventilation.

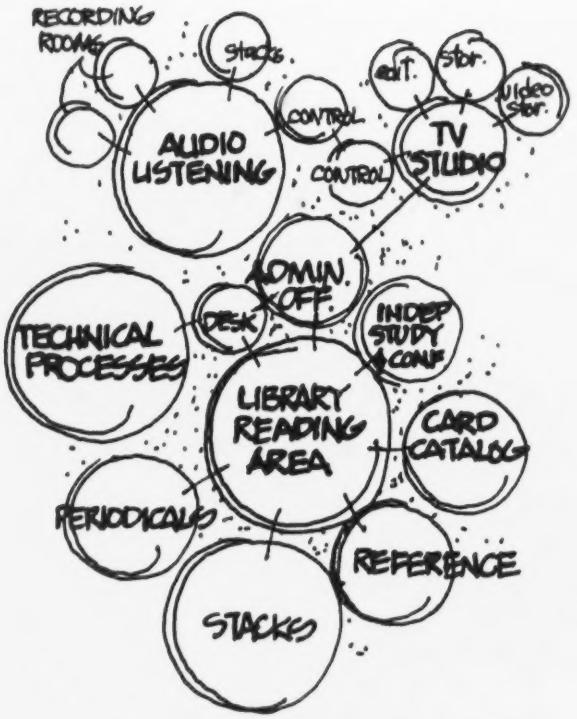
Potentially dangerous equipment such as lathes and band saws should be located to receive natural light during the daytime and emergency lighting at night. This provision minimizes the potential for an accident in the event of a power failure causing a loss of primary lighting. Natural light and ventilation are also important for purposes of energy conservation. 120 volt outlets should be conveniently located for the use of portable power tools. Hot and cold water and appropriate clean up facilities should be accommodated. Areas where portable and bench power tools are kept should be lockable so that unsupervised use cannot occur.

The use of sound-absorptive materials in ceilings is critical. Demountable metal walls are functional for areas not requiring plumbing because they allow for rearrangement at minimal cost. Wall surfaces should be coated with durable, easily cleaned surfaces. Overhead buss bars are useful for electrical service in many shops. Interior and exterior metal doors are suggested for all trade and vocational shop entrances and exits. Hardwood maple floors, tongued and grooved, are effective where woodworking equipment and tools are used. Concrete is needed in hot metals, transportation, and power mechanics areas. Resilient tile, such as vinyl asbestos, asphalt, cork, and rubber, can be used in the office and in electronics spaces.

Conveniently placed tool and supply centers in each shop are necessary for storing general supplies and tools. Where several shops are clustered into one center, tool and supply centers may be designed to serve adjoining shops. It is highly desirable to decentralize storage for tools that are used exclusively in particular activity areas. This can be done by installing fixed tool storage and display panels or by providing portable ones. It is also desirable to place rough metal-trimming equipment in or near supply rooms in order to avoid handling of large and awkward pieces of stock in work areas. Supply centers should allow convenient delivery of supplies. These centers need doors of sufficient width to permit passage of heavy equipment, large pieces of material, and vehicles. A room or space should be provided for student project storage. The amount of space



Newaygo County Vocational School, Fremont, Mich.; Daverman Associates, Architects



SPATIAL RELATIONSHIPS
LEARNING RESOURCES

needed will vary with the type of work being done. In some cases, lockers under benches are adequate; in other cases, a storage room with bins and adjustable shelving is necessary, particularly where facilities are used for evening adult classes.

Library/Learning Resource Center

The learning resource center is a space for the organization, storage, lending, and on-site use of learning aids for all school educational programs. It should house not only conventional library materials, (books, newspapers, periodicals, and pamphlets), but also recordings, tapes, filmstrips, slides, microfilm as well as equipment necessary for their use. The learning resource center should be comfortable and attractive. The environment should be pleasant and the space should be organized to permit quiet, solitary study, group interaction, easy location, inspection and use of materials, and convenient flow of traffic between areas. The success of the center will depend to a large degree, on the organization of space and materials, the furniture, and the manner in which the center is operated. Nevertheless, there are environmental features which contribute to the efficiency and comfort of the center. Planners should be in touch with these aspects.

The learning resource center should be centrally located to insure easy access. A main floor location is usually preferable. The center should be located away from noisy areas like the gymnasium and should be placed so that physical expansion will be possible if necessary. Another consideration in locating the center is access from outside when other parts of the school building are closed.

The size of the facility should be appropriate for school enrollment and should accommodate the current collection of printed and other materials as well as anticipated acquisitions. The nature of the facility will depend on the educational level of the students although there are some common requirements which are unaffected by the age of the users. For instance, carpeting of floors will insure a low noise level; walls should be treated to so that maintenance requirements are not excessive; ceilings should provide desired acoustical level; heating and ventilating outlets should be installed so that they do not interfer with shelving and so that heat flow will not damage books; electrical outlets should be accessible where audio-visual and other equipment will be used.

Normally the learning resources center will contain the following areas: a main reading area; an audio-visual area; an area for independent study and research; conferences and seminar space; a library

workroom and an office for the library staff. These areas may be located in separate rooms or they may be combined depending on the size of the total space and the complexity of the center.

The main reading area will normally contain tables and chairs, lounge or casual furniture, the card catalogue, circulation desk, reference books, reserve materials, and display space for current periodicals and newspapers. In elementary schools, the main book collection is often located in the reading room, whereas in secondary schools, the collection is occasionally housed elsewhere in stacks.

A room or area for the storage and perhaps the use of audio-visual equipment such as teaching machines, record and tape players, may be part of the center. Electrical outlets are an obvious necessity. Study carrels designed for the individual use of this equipment may be located in the audio-visual room or elsewhere in the center.

Areas for independent study and research may either be included within or separate from the main reading room. The carrels may be wired and otherwise equipped for the use of audio-visual equipment or may be dry. Spaces for group discussion may be located in a separate room, or conference style tables and chairs may be placed in the main reading area. Audio-visual equipment, projection screens, and chalkboards may be used. A more informal approach to group use is the provision of casual seating. Group study spaces should be located in the vicinity of resources which will be needed by users.

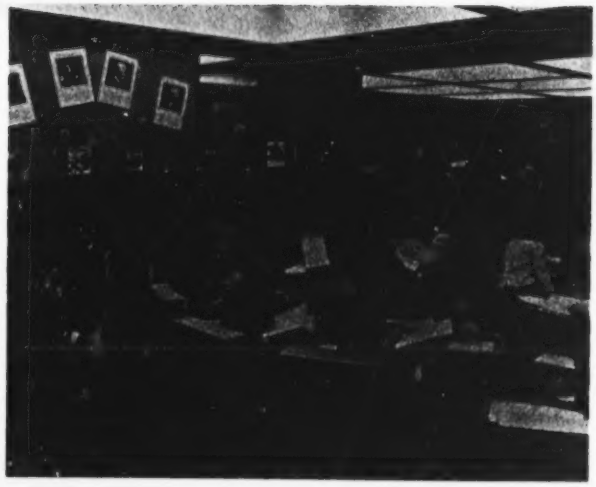
A workroom with appropriate cabinets, shelving, cupboards, electrical outlets, and a sink with hot and cold water should be provided. The workroom can be used for the preparation of materials for circulation, repair, and possibly storage space for items not in use.

The office for the library staff which should accommodate a desk, chair, filing cabinet, shelving and other specified equipment, may be located in conjunction with the workroom.

Shelving is of primary importance. Its quality and size must be carefully computed and it should be adjustable to assure flexibility. The height of shelving units should be geared to the size and age of students. Height between shelves should be appropriate for the size and volumes to be stored. Picture books used in elementary schools may be displayed differently and because of their size may require larger shelves than those used in secondary schools. Stack type shelving for printed material which is common in secondary school centers should be centrally located, accessible, carefully organized and convenient for traffic flow.

J. L. Buford Elementary School, Mt. Vernon, Ill., Fields, Goldman & Magee, Architects

Norwell (Mass.) High School, The Architects Collaborative; photo by Steve Rosenthal



Kemsville Elementary School, Whitehall Tnshp, Penn.
Breslin, Rolyard, Fadero, Architects

If a television and/or radio studio is planned as part of the complex either for the teaching of broadcasting techniques or for use in the creation of instructional materials for other educational programs within the school, environmental needs will have to be carefully investigated to accommodate specialized equipment.

H

AUXILIARY SPACES

Thomas Jefferson Jr. H.S.; Vosbeck, Vosbeck, Kendrick, Redinger, Architects. Photo by J. Alexander.

Percy Julian High School, Skidmore, Owings & Merrill, Architects

Auxiliary Spaces

Auxiliary spaces in educational facilities support the instructional program and accommodate out-of-classroom needs of both students and staff. The design possibilities for such spaces have increased with the emergence of diverse concepts in school design, increased use of non-printed media, expanded awareness of student/teacher human needs, recognition of the school as a community resource, and improved technology.

The planning of auxiliary spaces must involve careful consideration of the future adequacy of the spaces for, while additional classrooms can be appended with some ease, the expansion of auxiliary spaces can seldom be accomplished easily after completion of initial construction. Thus, when auxiliary facilities become obsolete and inefficient, the usefulness of the entire facility may be diminished.

This Unit will consider basic environmental requirements for the following auxiliary spaces:

- Auditoriums
- Food Preparation, Service, and Dining Facilities
- Student Commons
- Faculty Facilities
- Offices for Administrative Personnel
- Guidance and Counseling Center
- Health Office

Multi-Purpose Spaces

Before discussing general requirements for auxiliary spaces, some mention should be made of spaces which are designed to serve a variety of functions: rooms which serve as combination auditorium-theatres, auditorium-gymnasiums, cafeteria-gymnasium-auditoriums, and so on. In planning auxiliary spaces which are adaptable to multiple use, the basic functions of the spaces must first be determined. Sharing of a space by unrelated functions may result in reduced area, extended use, and lower school construction and operation costs. However, special care must be taken in designing areas for multiple use since the shape, size, acoustics and other environmental factors desirable for one use may be entirely impractical for another. Multi-purpose spaces, while they are possible, are therefore seldom better because of the compromises to which they are subject. Their functionalism may be so reduced that they do not serve any of the planned uses as well as separate facilities.

In addition, multi-purpose spaces may encounter scheduling difficulties. Frequent shifting of furniture and equipment is another drawback. The cost of extra storage spaces or special equipment, such

as operable partitions needed to achieve satisfactory multi-use, may cancel expected savings.

Multi-purpose spaces should be cautiously and thoughtfully planned with the full recognition that they may have serious deficiencies affecting one or more of the uses to which they will be put.

Auditoriums

Designing an auditorium is an effort which requires considerable technical expertise. Designing a *good school* auditorium requires not only technical proficiency, but considerable imagination and luck as well. The difficulty is that school auditoriums must serve numerous functions which have dissimilar environmental requirements. For instance, acoustics and stage space that suit instrumental and vocal concerts are inappropriate for dramatic productions. Therefore, it is not unusual to find a school auditorium which has been designed to serve one purpose and operates to the complete disadvantage of others or which has been designed to handle a variety of functions and supports none of them well.

In spite of this grim predicament, it is possible to design a satisfactory assembly-performance-lecture hall if use is made of theatrical and acoustical consultants, if the architect has had prior, successful experience with auditoriums, and if expectations of the facility are reasonable and are specified in advance. Another factor which will assist the design of a functional auditorium is the elimination of all requirements related to dramatic productions. A small laboratory theatre which will provide an intimate, serviceable space for dramatic productions can be located elsewhere in the educational facility. (See Unit G)

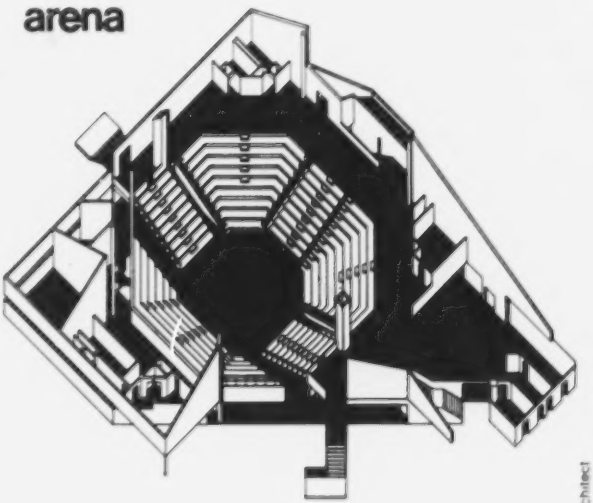
Although this section cannot outline all of the environmental and technical requirements of auditoriums and theatres, it will attempt to provide some basic information about these spaces, namely types of auditoriums and audience-performer relationships, types of seating, acoustics, capacity, and divisibility.

Four basic types of stage area are possible in auditoriums. Each creates a distinct audience-performer relationship.

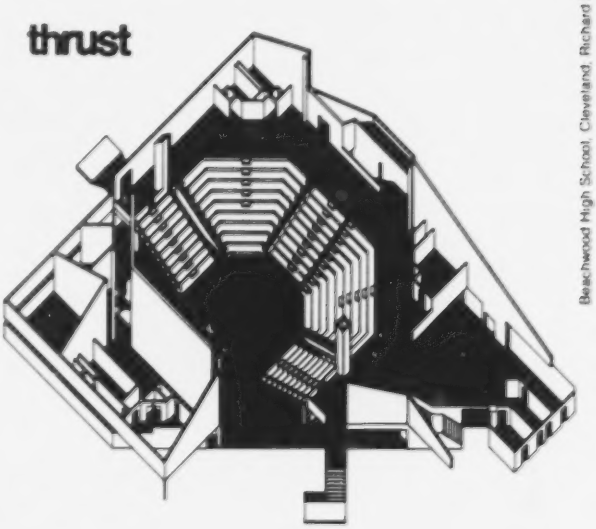
The *arena stage* has audience seating surrounding the performance area. Acoustically it is unsuitable for music because of poor instrumental balance. Visually it is unsuitable for films and lectures because of poor sightlines. Dramatic productions can, however, use this style space to advantage.

The *thrust stage*, in which the audience is seated on three sides of the performance area, has drawbacks similar to those stated for the arena stage.

arena

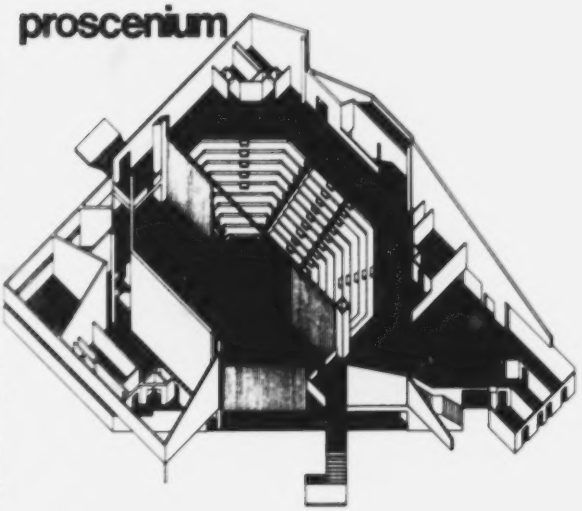


thrust



Beachwood High School, Cleveland, Richard Fleischman, Architect

proscenium



Beachwood High School, Cleveland, Richard Fleischman, Architect

open

Beachwood High School, Cleveland, Richard Fleischman, Architect

The *proscenium* separates the auditorium and stage spaces. Essentially, the audience is seated in one room and the stage is located in another room behind the proscenium frame. Because of the high stage house needed for rigging and flown scenery, and because of the soft, sound-absorbing curtains, the proscenium stage is usually acoustically inappropriate for musical concerts. Expensive concert shells must often be utilized to make the space suitable for music. In terms of equipment, an auditorium with a proscenium stage is very costly.

An *open stage*, which unites performance and audience spaces within one room and locates audience seating on only one side of the performance space, is the most flexible arrangement for lectures, concerts, and theatrical productions. Walls, ceiling and floor can be designed so that the need for a concert shell is reduced. Required back stage equipment is not so elaborate as that needed for the proscenium stage.

In all cases, regardless of the type of stage plan, acoustical and theatrical technicians should be consulted and should be allowed to contribute to the design of these spaces.

The stage floor should be yellow pine, tongue and groove, laid on sleepers and resilient pads. A dark surface is desirable. Back-stage requirements, especially if the auditorium is to be used for dramatic productions, will include space, electrical circuitry, and plumbing for a scene construction shop and storage. There must be adequate space both to the sides of the performance area (the wings) and behind the performance area (upstage). A receiving dock and entrance should be provided.

Lighting equipment is a highly specialized and technical area which should be explored with the assistance of a professional designer or consultant. Accommodations for projection equipment, either rear or frontal, and a public address system are other considerations involved in auditoriums.

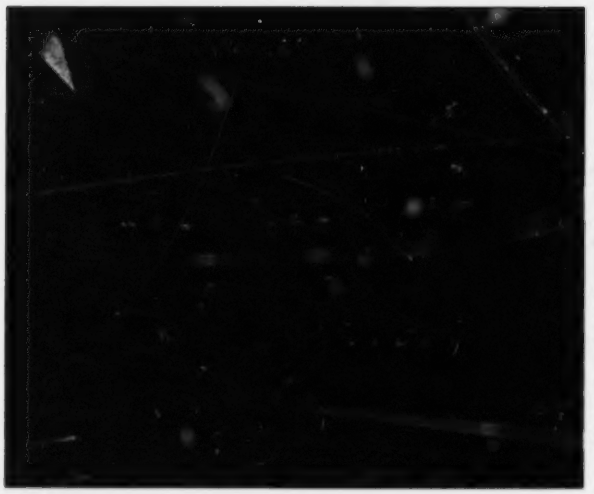
The capacity of the school auditorium should be thoughtfully calculated in view of projected use of the space and availability of alternate spaces for large assemblies. The provision of seating for massive crowds is ordinarily of dubious value. Not only are large auditoriums expensive in terms of seating and space, but they can also be plagued by acoustical problems, lack of intimacy in the audience performer relationship, and poor sight lines.

Audience seating can assume two basic forms. Continental seating employs unbroken rows of seats. Conventional seating has one or more interior aisles. When continental seating is used, the measurement between the back of seats in one row and

the back of seats in the next is slightly larger to accommodate movement between rows.

Divisible auditoriums have suffered a fall from favor because of the near impossibility of creating optimal spaces through the use of partitions which, however costly and skillfully designed, never create complete aural isolation and are often accompanied by visual and acoustical drawbacks. Divisibility often results in the construction of auditorium spaces which are unnecessarily large. Regular classrooms can provide a comparable environment at less cost than these arrangements.

As mentioned before, acoustical demands of music are quite different than those of speech. Quite simply, music requires a longer reverberation time. Various commercial devices (concert shells, reflectors) are available to improve on a less than ideal acoustical situation and to enhance musical performances.



Athens Sr. H.S., Troy, Mich.; Warren Holmes Co. & Kenneth Black, Architects

Food Preparation And Dining Facilities

The planning of facilities for food preparation, service and dining is best accomplished by a cooperative effort among the food service administrator, the architect, and an equipment supplier. A food service consultant may also be hired to assist with the process. The objectives are (1) to provide an efficient and healthful working environment and (2) to provide a pleasant dining environment.

A basic facility will include spaces for the following activities: receiving, storage, cooking, serving, dining, dishwashing. Office space for the administrator and locker and toilet facilities for the kitchen staff may also be required. These spaces should be arranged in such a manner that persons, food, and supplies can move or be moved conveniently from one space to another in a logical progression. The maintenance of health and safety standards is obviously imperative, and the facility should be designed to promote cleanliness and easy maintenance.

General requirements for the above mentioned spaces are as follows:

Receiving Area: The receiving dock should permit easy unloading of supplies and food onto a roofed platform. This area should be located away from student traffic. The floor level of the dock and the storage/kitchen areas should be the same.

Storage: Storage for food items which do not require refrigeration should be adjacent to the receiving area and convenient to the kitchen. This area should be dry and clean. Storage space for non-food items should be convenient to the receiving area and the dishwashing/maintenance areas. This space should be well-ventilated and may contain a sink with hot and cold water.

Lowell (Indiana) Middle School; KM Associates, Architects

SPATIAL RELATIONSHIPS
DINING FACILITIES

Kitchen: The type of kitchen planned will depend on the nature of the food service program. Is the food to be prepared on site or will it be delivered from a central kitchen? What type of food will be served — hot meals, convenient pre-packaged foods, vended items? The size of the kitchen will depend on the nature of the equipment and the number of people required to prepare meals. Food preparation equipment is expensive, and it should be chosen with care *before* the kitchen can be designed. Refrigerators and freezers for food storage — if required by the program — must be planned for and accommodated.

Service: Food service may occur in a section of the kitchen, in a separate room, or in the dining area. The space needed, the equipment required and the arrangement of service counters will be determined by the food preparation/service program. The objectives here are to facilitate an attractive display, easy selection, and quick service of food. Efficiency is vital: persons should not have to endure long waits in lunch lines.

Dishwashing: The dishwashing and maintenance area should be located adjacent to the dining room, preferably near its exit. Equipment selected for cleaning dishes and utensils will determine the size of the space. Garbage and trash disposal should also be accommodated in this area.

Office: Enclosed office(s) for the head cook and/or administrator will be needed to accommodate menu-preparation, purchasing, and other tasks related to the management and supervision of the kitchen. The office should have a window providing a view of the kitchen and serving areas.

Staff Facilities: The kitchen staff should have conveniently located locker, lavatory and toilet areas.

Dining: The planning of the dining area will require careful consideration of spatial requirements. The number of persons to be accommodated, the seating arrangement, and the type of furniture to be purchased are some considerations which affect size. If there is only one lunch period, the space must be larger than if students dine in shifts. The dining area should be properly illuminated and ventilated; it should be treated for noise control; it should be cheerful and clean; it should be durable and easily maintained. Care should be taken to provide an attractive and comfortable environment.

At all school levels, the dining area may sometimes serve as an auditorium, a ballroom, a registration area, and a large-group classroom. Multi-use of the space calls for extra attention to acoustics and design. For instance, load-bearing columns down the center of the room, while not a hindrance to dining,

Bennenhasset Elementary School, Woods Cty., W. Va.; Sounik/Eller/Martin, Architects

may preclude use of the area for assemblies by ruining sight lines. Alternative and additional uses should therefore be anticipated and planned for well in advance.

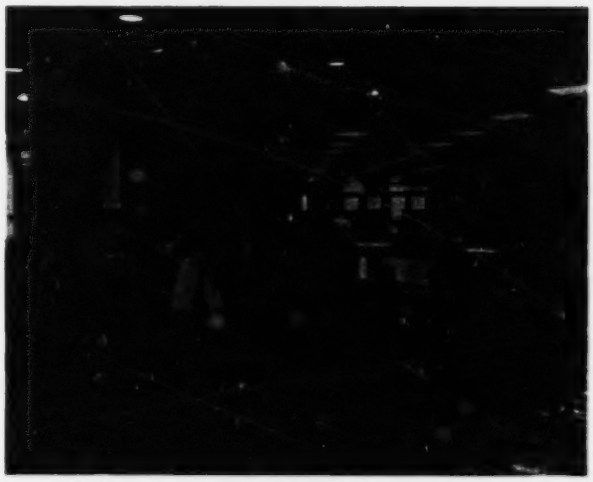
It should be noted that the type of food service program operated by the school will depend on the location of the school and the ease with which deliveries can be made. Site therefore influences the type of kitchen facility which will be needed and the type of equipment which must be purchased. Thus, if a school is in a rural area, daily deliveries from a central kitchen may be impractical, and a fully equipped, independent kitchen may be a necessity. Furthermore, a remote location may call for the installation of large freezers for the storage of food which would not be necessary in a suburban school to which deliveries could be quickly and easily made.

If the preparation and packaging of food is accomplished at a remote location outside the immediate school, the elaborate cooking, service and clean-up facilities described above are superfluous. When such service is implemented, students can obtain their lunches from a counter or service table and, if trays, plates, etc. are disposable, the entire package can be discarded, eliminating the need for dishwashing equipment and staff. The installation of vending machines may also simplify the nature of other food service facilities.

Student Commons

The student commons is a central location in the school where students can congregate for relaxation, conversation, committee meetings, study, and snacks. Its purpose is to nurture social and personal as well as academic advancement and to provide for student-teacher interchange in an informal atmosphere. Because students require association with their peers in out-of-classroom situations and because much of what students learn comes from mingling informally with one another and with faculty, the commons fulfiils very basic needs.

Although the student commons should be centrally located — perhaps in conjunction with a library, auditorium or dining area — it should also be somewhat secluded. It should always be available for use and furnished as a place for informal study and socializing. Snacking facilities may be incorporated within or adjacent to the area. With modular scheduling operating in many high schools, the study/lounge student commons is essential because it provides a place for the students to go during their unscheduled time. It provides a social environment which the formal learning resources center does



Gateway H.S., Aurora, Colorado; Wm. Blurock & Partners, Architects

not. It exists as an option for students, an alternative environment.

The commons should be furnished with study tables and chairs for small groups, as well as lounge-type seating. The atmosphere should be inviting. Students will probably be able to create an environment for themselves in this area, and they should at least be able to express their preferences in decoration of the space. In addition to food vending machines, the area may include telephones and typewriters.

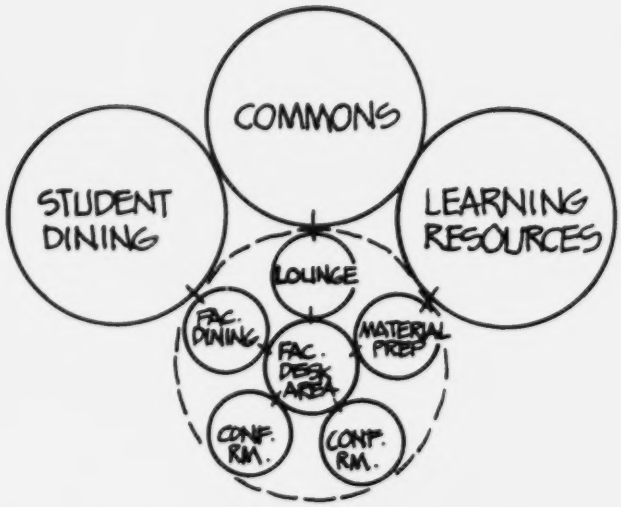
Multi-purpose rooms are programmed areas and they allow little opportunity for casual student association on a consistent basis because of the regular changes to which they are subject. It is very important that the student commons *not* be a multi-purpose room. The commons is students' space and it should not be periodically changed as tables and chairs are introduced, removed, or rearranged to support a variety of functions.

Faculty Facilities

Spaces for out-of-classroom use by faculty members are required for preparation of teaching/learning materials, conferences, and for relaxation. If it is determined that the faculty will dine separately from the students, then dining facilities are another need which should be considered.

The type of space provided for teachers' use in planning and developing materials will depend on the general nature of the facility. If classrooms are enclosed and a teacher is scheduled to work in one space all day, then the classroom serves as an individual office and can be used for much preparatory work. This arrangement does not preclude the need for a separate, common facility where teachers have access to materials, machinery, and space with which to create instructional materials. When teachers move from one learning space to another during the day, there is an obvious need for private work and storage space, which can be used for preparing lessons, resource materials and displays, interviewing students and parents, evaluating student work, and so on.

A space which serves this function can assume a variety of forms. It can be a central work area with individual desks for all teachers — located near a central dispository for supplies and equipment. Proximity to the learning resources/media center may be desirable. Another possibility is the grouping of teachers' desk and work spaces in departmental offices. Whatever the solution, the location of the teacher preparation/office areas should be near learning spaces to allow convenient access for both students and teachers. Small, private rooms should be planned for interviews with students and/or par-



SPATIAL RELATIONSHIPS
FACULTY SPACES

ents when no other space exists for confidential or uninterrupted conversation.

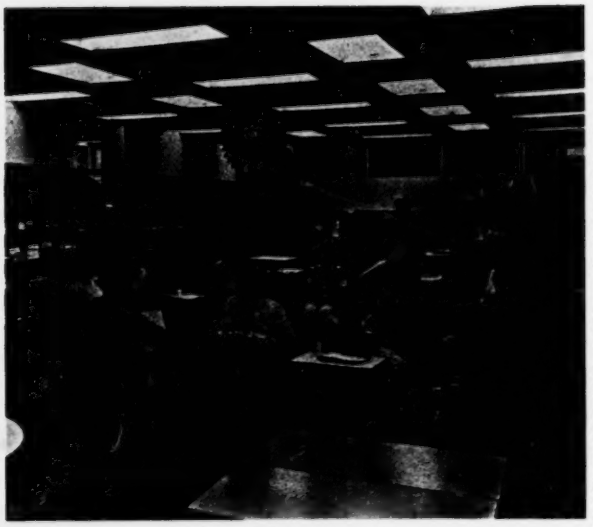
A variety of arrangements are possible for the accommodation of refreshment breaks, rest, and socialization for faculty members. It is generally conceded that the faculty needs informal gathering space away from student traffic. There is merit, however, to locating such private spaces near student commons to allow informal student-faculty association. Like the student commons, the faculty lounge should be informal and always available. It should not do double duty as a meeting room for teachers, for delegations calling on the principal, for PTO committee meetings or other functions which would convert the space into a multi-purpose room. The faculty lounge should be furnished with comfortable seating as well as tables and chairs. Carpeting and other amenities that will enhance the attractiveness of the space are equally desirable. It may be convenient to locate faculty toilets adjacent to the lounge.

If separate faculty dining facilities are to be provided, it is possible to combine the lounge and dining facilities. If this solution is chosen, the faculty lounge will must be placed in close proximity to the main food service/dining area. This dual use will introduce new area and furniture requirements.

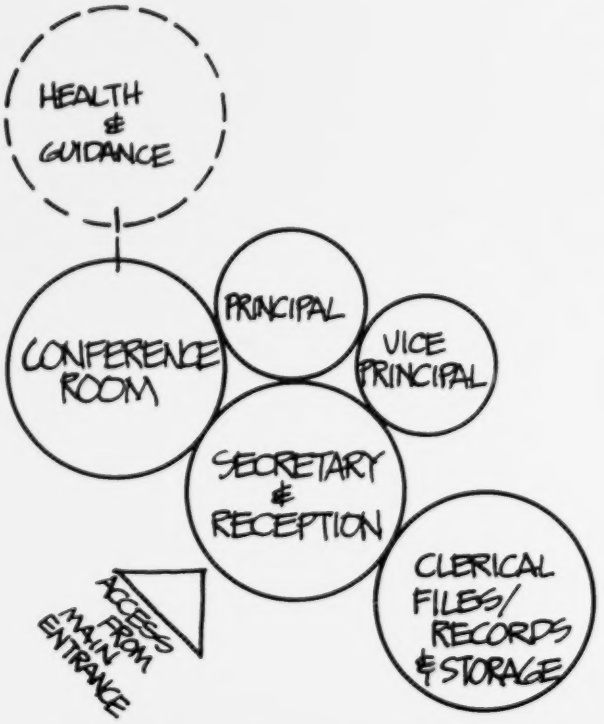
Offices For Administrative Personnel

The number and nature of offices for the school's administration and for special services personnel will depend on the type of the facility, size of the enrollment, the kind of special services provided, and the extent of community use of the facility. In spite of these variables, the general administrative suite is ordinarily located near the main entrance of the school. Regardless of design, whether open or contained, it should incorporate a public reception/waiting area, desk and work space for the school's secretarial staff, mail boxes for teachers, the control panel for an intercommunication system, the control panel for signal and tone system, a master clock and controls, and the telephone switchboard. Provision should be made within this general area for storage of administrative supplies, school records, duplicating and other office machinery, and perhaps instructional materials if they are not kept elsewhere.

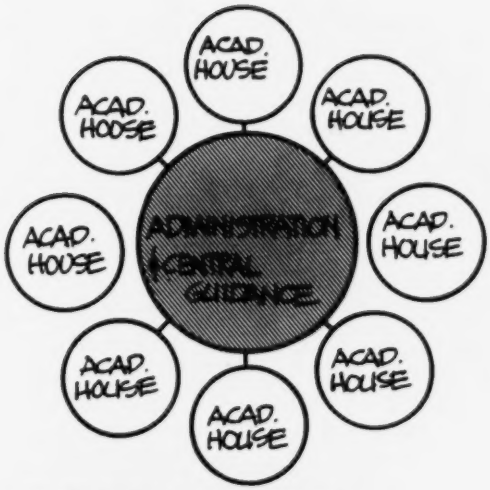
The office of the school's principal should be located adjacent to the main reception/information area. It should be large enough to contain a desk and chair, seating for three or four persons, bookcases, and cabinets for storage. The principal's office should be accessible to the secretary. It should be private — both sound-proof and without interior



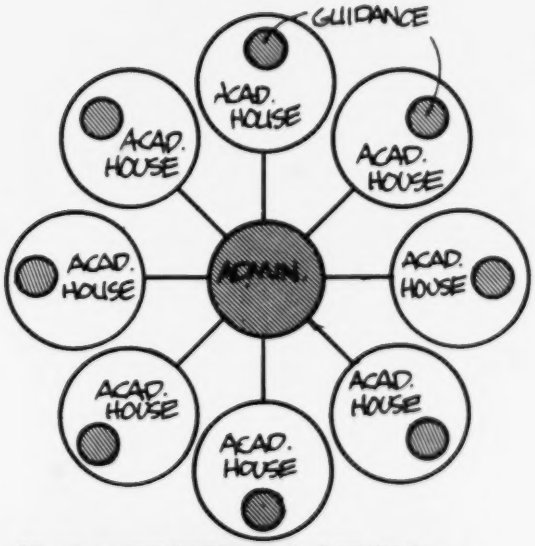
Walt Disney Magnet School, Chicago; Perkins & Will, Architects



ADMINISTRATIVE SUITE
PRIMARY SCHOOL



CENTRALIZED GUIDANCE CONCEPT



DECENTRALIZED GUIDANCE CONCEPT

windows. A comfortable and pleasant atmosphere is important.

It may be desirable to locate a conference area adjacent to the administrative offices. Furnished with typical conference style table and chairs, this room can be used by the school staff.

The arrangement of the administrative offices requires attention to tasks to be performed and the relationships of persons performing them, accessibility to students, teachers, and community visitors, convenience of stored materials, and ease of traffic flow. Attention to interior design and decoration is particularly significant since this is a central school area and an impression of the total facility may be formed here.

Staff offices which may be located in conjunction with the main administrative office and those of the school nurse, guidance counselor, and psychologist. Proximity to the main administrative area will facilitate communication and allow access to records. However, entrance to these areas should not be through the administrative offices. Each of the special services should have its own distinct entrance and its location should be clearly identified.

Guidance And Counseling Offices

Guidance offices should be quite separate from the administrative office and should contain at least two main areas: an informal display/reading/waiting room and a staff office(s). A storage/display area for occupational and educational information — college catalogues, vocational material, study guides — should be furnished with tables, chairs and comfortable lounge-type furniture. Books, pamphlets, films, and slides for students' use should be easily accessible. Shelving, display racks and cabinets should allow well-organized, highly visible arrangement of these materials. Tackboard should be provided. This space should be conveniently located and attractive so that students will be encouraged to use it.

Also needed in the guidance/counseling area is a room (or rooms, depending on the size of the staff) which will serve as the counselor's office and conference room. This area should be private — visually and aurally isolated — and should provide a relaxed, informal atmosphere. In addition to a desk and other office furniture for the counselor, this room should contain seating for two or three other persons.

Other possible components of the counseling area are a small room(s) for private testing and interviewing. If a psychologist is on the school staff or if professional therapists are rotated among schools

in the administrative unit, it is essential that a room be provided for meetings between these persons and students utilizing their services. Again, institutionality should be avoided in the design and decoration of these spaces.

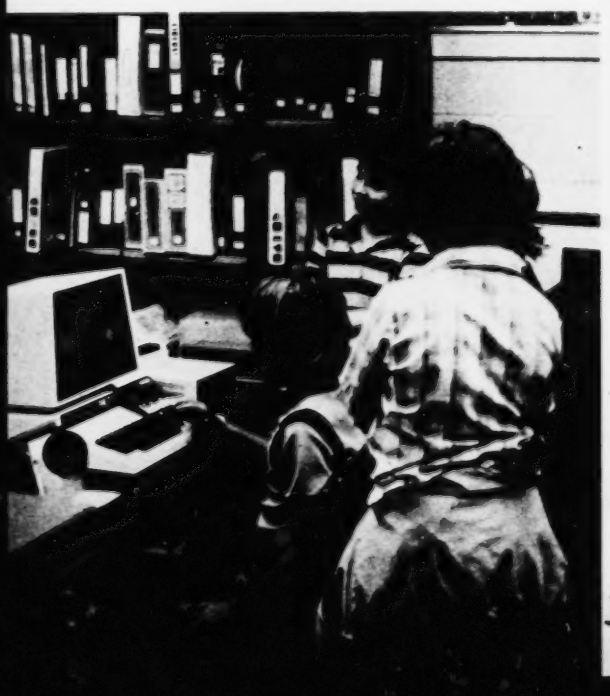
Health Center

The health center should be large enough to accommodate beds for ill students, space for first aid treatment and an office for the school nurse which can contain a desk, filing cabinets for students' medical records and storage for instructional materials. Dimensions of the health center should be such that there is space for testing — students should be able to get an appropriate distance from the vision test chart, for instance. Plumbing for a sink should be included in the design. A bathroom should be located adjacent to the health center. Electrical wiring for equipment must be considered. A telephone and a refrigerator will probably be necessary. Fixtures for suspended screening may be desirable.

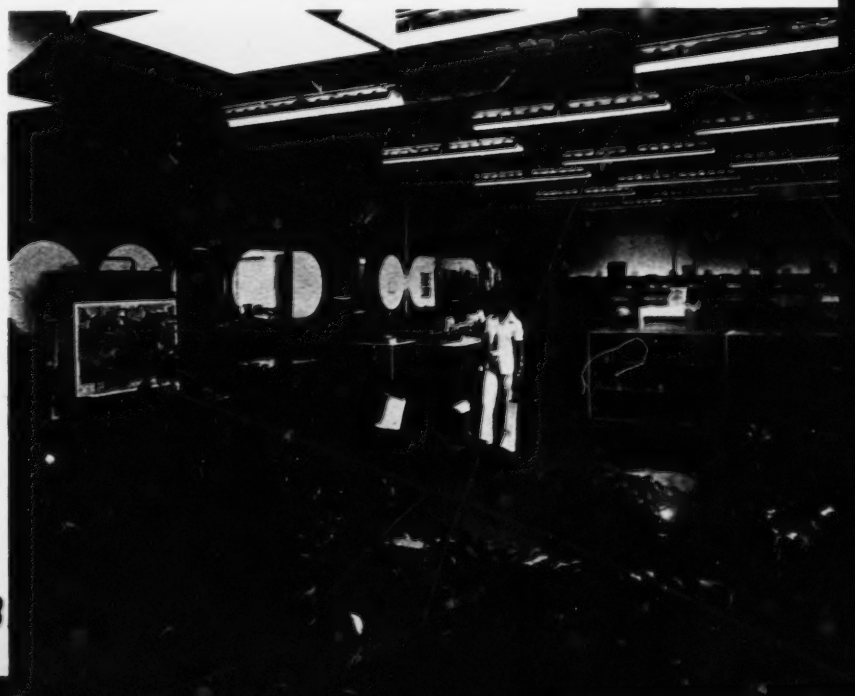
Obviously, if the school health center is to be used as a community health clinic, its physical and spatial requirements will increase in complexity and number. Access from outside the building, waiting rooms, examination rooms, laboratory space and a physician's office, as well as equipment and furniture for these areas will need to be considered.

Pleasantville Cottage School; Frost Assoc., Architects, photo by N. Lieberman

THE LEARNING ENVIRONMENT



Computer use — elementary media center, Bowen Elementary School, Kentwood, Michigan. Photo courtesy of John Sampson.



Bellamy Elementary School, Tampa, FL. Rowe-Holmes, Assoc., Architects.

Everything man does is associated with the experience of space. Nothing occurs....without a spatial context. Edward T. Hall

It has been known for a long time that human beings are both consciously and subconsciously affected by their environments. The physiological and, to some extent, psychological effects of the built environment in terms of heat, light, sound and space have been explored and documented. And though research has not yet supplied complete answers about the effects of the built environment on human attitudes and behavior, it has indicated that the environment **is** an integral part of the learning process.

Research also has focused on the importance of the environment as it affects the residing individual. It has been suggested that the kinds of environmental decisions we make today will affect the types of people who will inhabit our earth in later generations.

But when we speak of environmental influences and environmental stimulation in terms of the learning environment, what do we mean? And what has been the evolution of classroom design in school facility planning?

Bellamy Elementary School, Tampa, FL. Rowe-Holmes Assoc., Architects.

When one confronts the reality of the typical classroom—sterile, monochromatic, monotextural, and unprovocative—one might rightly question the evolution of classroom design, the appropriateness of its "fit" in 20th Century curricula and the environmental message that is being attempted. With increasingly innovative designs in curricula, there does not seem to have been correspondingly innovative designs for the spaces in which these curricula are delivered. Creative planning often has stopped at the classroom door.

Man is at once both the center of his environment and an integral part of the environment, both biologically and sociologically. There is a constant exchange in the man-environment relationship and an ongoing intercourse on both a conscious and extra-conscious level. The environment should not be considered merely a container for human activity, but an integral part of a pattern of behavior. Likewise, the student and teaching environment can be viewed as a single system. This system, dynamic and in a constant state of reciprocity, should demand **total,** multisensory participation of the student, using as many channels of communication as possible. The student exists and responds in a state of ongoing exchange with his environment, limited only by the level of richness of stimuli it provides.

The stimuli must be orchestrated by the architect and educator working in concert. They should develop a conceptual basis for facility design that includes concrete examples of curricular concepts across subject matter disciplines. The spaces should meet all the developmental needs of occupants at important levels of human functioning and habitability.

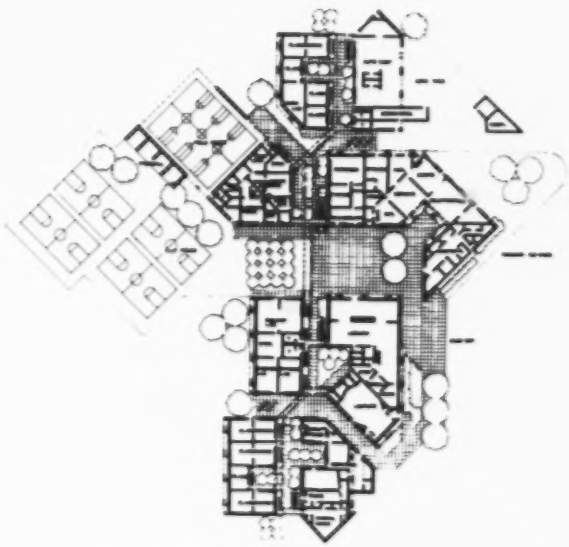
Space

Space as a design factor in learning environments has assumed new meaning. Those concerned with programming and planning educational facilities can no longer assume a set of fixed conditions based on projected enrollments and resulting in a conventional arrangement of established spaces populated by a given number of students. While the double loaded corridor, the finger plan, and the self-contained classroom characteristic of past decades are still valid planning solutions for certain types of educational programs, their unchallenged acceptance as educational environments is defunct. Educational practice now includes the arrangement of flexible space for large and small group and individual study situations. New forms and new geometry are used in designing contemporary schools. Obviously, air conditioning, lighting, acoustics, and color have been affected by these innovations. The techniques for controlling an environment of fluid dimension and changing character, an environment incorporating a variety of sizes and shapes and ambient qualities, are considerably different from those used in controlling a fixed and uniform condition.

Because most educational specifications have expressed spatial needs in terms of square footages, there has been a tendency to ignore the implications of height and volume. With the fixed conditions of the past, ceiling heights were fairly well established, occasionally by state regulation. Shape and floor area were sometimes subject to standardization also. Now, in creatively designed schools, these dimensions can evolve out of the integrity of the design and a sensitivity to human need for variety. Squares, rectangles and right angles are no longer ubiquitous. Circles, octagons, and any other forms that are workable and visually interesting are acceptable. No longer must ceilings be monotonously flat; they can be structured to provide desired acoustical, light, visual, and architectural treatment. Outdoor spaces have also assumed new importance. The interconnection of interior and exterior areas has been developed in some school buildings. The site can be utilized not only for its recreational and educational value, but

PERKINS & WILL

FLOOR PLAN



Woodbridge High School, Irvine, CA.

also for its usefulness as a pleasant gathering place for students and staff who wish to relax and socialize.

Indoor/outdoor, dark/light, protected/open, quiet/busy—these are options in terms of space which are now considered advantageous in educational environments. Changing construction techniques, the availability of new materials, and the freedom to be imaginative and responsive to a fuller range of human needs and sensitivities have contributed to these improvements.

Aesthetics

Ugliness is a pervasive element both in the built environment and in those natural spaces and features that we have abused. Sensitive people have written eloquently and extensively about this condition and there is little point in repeating their observations here. However, it should be apparent that one of the primary reasons we are able to live amidst so much appalling ugliness is that we either do not see it—we have ceased to perceive and be responsive—or we do not know the difference between what is beautiful and what is not.

Developing an ability to recognize and appreciate beauty in both the built and natural environment should be a primary responsibility of our educational system. The school building has a significant role to play in this area. Children and young adults spend enormous amounts of time in educational facilities. In a twelve year association they can learn to appreciate quality via aesthetic and human considerations in building design. Or they can become increasingly alienated from, and insensitive to, their environment via physical surroundings that are colorless, cold, bland and institutional. The school building is influential in developing the kinds of expectations people will have and will later express in creating their own environments.

It is therefore essential that educational facilities be designed with careful attention to those elements that contribute to the aesthetic development of the users and that respond to an elemental need and appreciation for what is beautiful. Attendance at an attractive school should be neither a stroke of luck that goes along with having an enlightened school board and a creative designer, nor a privilege of the affluent. Planners, designers, citizens who pay for schools, and those who use them should insist upon beauty in their schools. This means attention not only to color, texture, line, and form in the structure of the building itself, but to the incorporation of paintings, sculpture, collage, mobiles—all types of art forms created by both professional and student

artists—in the decoration and enhancement of the educational facility.

Color

It has been suggested that color plays an important part in the way we act in our environment. However, limited research has been conducted on color as it relates to learning. Color experts do feel that the warm colors (red, orange, yellow, pink) tend to stimulate us into action, while the cool colors (blue, green, gray) tend to relax us. Therefore it is important to select a color appropriate to the activities of a given learning area. One consideration is that colors may affect students differently at different age levels and in different learning activities. For example, colors used effectively in a media center at the primary level may not be appropriate at the secondary level. The type of lighting used may also affect color in subtle ways, so the relationship between lighting and color should always be considered. In general, school planners should recognize the impact of color and how it can influence the attitudes of users of the school environment.

Lighting

Since vision plays a major role in the communication of knowledge, conditions that allow adequate visibility should be provided in educational facilities. A good visual environment permits fast, accurate and comfortable vision. Level of illumination is not the sole factor responsible for producing these conditions. Balanced brightness in the environment and the elimination of glare also contribute to visual accuracy and comfort.

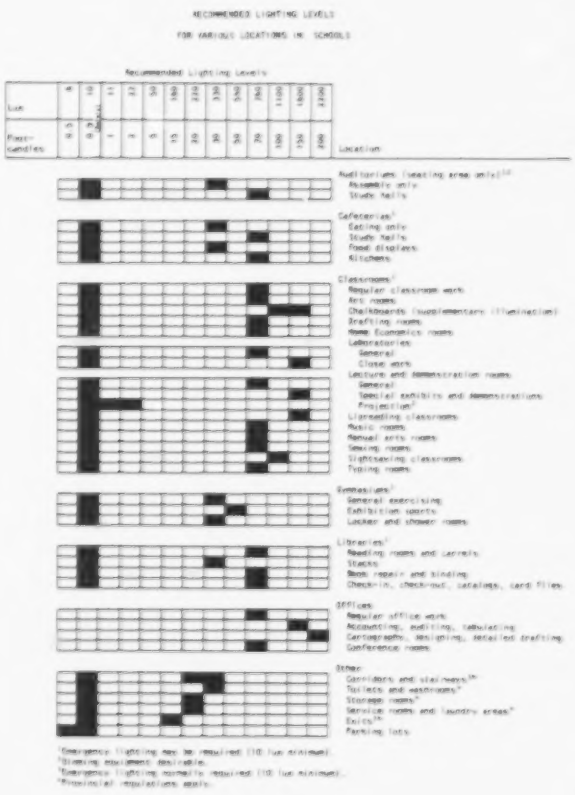
This section explores general principles related to lighting that have evolved out of research and experience, practical application of these principles in terms of luminaires and environmental treatment, and the implications of responsible energy use for school illumination.

Illumination level. Sufficient light should be provided to permit the performance of a visual task taking into account its size, configuration, contrast of object and background, and distance from the viewer. Illumination is measured in footcandles. A higher level of illumination in terms of footcandles does not guarantee that a luminaire is more effective than one with less output. Efficiency of a luminaire is measured in terms of Equivalent Sphere Illuminance; ESI is a measure of glare-free illumination. Lighting systems of 90 to 100 footcandles light equal only 20 footcandles of glare-free light when evaluated with a field task photometer. The achievement of a high ESI is the objective of all lighting systems. A lighting system that merely produces a

Factors Affecting Color Choice

- Geographical Location
- Nearby Structures
- Size of Rooms
- Shape of Rooms
- Interior Architectural Problems

Nancy R. Smith
CEFP Journal, March-April, 1980



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high level of illumination may be totally inadequate, even damaging, because of glare or low contrast due to veiling reflectances. In addition, energy is wasted in producing inefficient footcandles. The level of illumination required to insure visual accuracy depends on the nature of the task. For instance, in a test case a task in pencil handwriting required 63 footcandles to provide the same visual accuracy as a task in ink handwriting under 1.4 footcandles. The difference in required footcandles was due to the low contrast between grey pencil lines and writing paper as compared to black ink lines on paper.

Pencil handwriting is recognized as the most difficult common seeing task in schools and therefore it has been used as the basis for most lighting recommendations. The recommendation that 63 footcandles of glare-free illumination be provided for optimum seeing conditions has recently been criticized because the test case on which it was based was an extreme one. The level of illumination required to perform this task may be unnecessary for the perception of other objects with higher contrast. Some authorities reject not only the recommendation, but suggest that alternative writing instruments (black felt-tip pens, for example, which produce high contrast marks on white paper) be utilized in schools and thereby obviate the need for higher illumination levels. Now that energy is an important concern, the 63 footcandles recommendation has encountered additional questioning. It has been noted that students in countries other than the United States with lower lighting level standards seem to learn as well with no greater frequency of eye problems.

Brightness ratios. Brightness may be defined as the amount of light emitted from a light source or reflected from a surface per unit of area.

When the eye fixes on a task, the eye adaptation level is established based upon the task and surrounding brightness. When the point of regard shifts to another area, such as a window or chalkboard, the eye automatically adapts to a new brightness level. When brightness differences are nominal, adaptation is not a problem. However, if brightness differences are large, more time and energy are required for adaptation. For optimal visual efficiency, the brightness of the task should be equal to or slightly greater than that of its immediate surroundings. It is important to become aware of the changing tasks in educational facilities that now must be looked at, such as computer usage.

Brightness balance. The following guidelines have been recommended to achieve brightness balance:

1. No large areas should have a brightness less than one-third the task brightness.
2. No area adjacent to the task should be brighter than three times the brightness of the task.
3. No area in the visual environment should be brighter than five times the brightness of the task.

The implication of these guidelines is that learning spaces should be designed so that light from windows and luminaires does not exceed the adaptation level of the human eye. Intensity of light is not the sole issue here; the way light is directed and reflected affects brightness levels and balance.

The type of luminaire also affects brightness balance. For instance, pendant and surface-mounted luminaires can provide light on the ceiling and thereby reduce the brightness difference between ceiling and luminaires. Suspended direct-indirect fixtures project a relatively small portion of light downward and a large part upward. Care must be used in providing adequate mounting height for indirect fixtures to insure an even light spread. If these fixtures are too close to the ceiling, there is a possibility of excessive brightness on the ceiling immediately above the luminaire with low brightness between the luminaires. Large area luminous ceilings provide uniform illumination with low brightness. The luminous area should, however, be extended to the edges of the ceiling so that corners and walls will have adequate light.

Brightness control largely depends on the size of the luminaire. Narrow luminaires of recessed or surface-mounted type are usually brighter than wide units. The lens or diffuser, the number of lamps per luminaire, and the output of the lamps are all basic factors in luminaire brightness. The final choice of size, type, and number of lamps per luminaire will depend on the desired level of illumination, the module size selected for space division, the brightness characteristics of the luminaire, and the efficiency of the total installation.

Uniformity can be obtained by placing luminaires around the periphery as well as at the center of a ceiling. This layout, when properly designed, increases wall brightness and improves brightness balance and visibility on chalk and tackboard surfaces.

Although there has been a trend to reduce window areas in classrooms (this is especially true in open space schools where reliance on mechanical systems of all types is necessary), energy economy demands that the drain on fuel resources be held down. Use of sunlight generally will be less expen-

RECOMMENDED ILLUMINANCES*

Classrooms	500 lux
Drafting and graphics rooms	500 lux
Laboratories	500 lux
Library reading	500 lux
Offices	500 lux
Shop areas	500 lux
Typing rooms	500 lux
Auditorium	250 lux
Cafeteria	250 lux
Gymnasium	250 lux
Library stacks	250 lux
Washrooms	250 lux
Corridors	250 lux
Mechanical rooms	250 lux
Storage areas	100 lux

* based on the report "Lighting for Education," Ontario Ministry of Education, 1981

sive than artificial light except in extremely hot or extremely cold climates where air conditioning and heating costs may change the balance. Undesirable brightness can be controlled with tinted glass, operable shielding devices and landscaping techniques.

In spite of the necessity for brightness balance, a degree of variety in the illumination of the school environment is desirable. Unmitigated high brightness has proved to be distressing for most people and should certainly be avoided. The objective is to achieve a degree of regularity that avoids high brightness contrasts and conforms to the recommendations listed above. Achieving this delicate balance is not a task for the inexperienced.

Reflectance. Every object reflects some portion of the light it receives. The percentage reflected is known as reflectance. Reflectance of surfaces in the school environment is a significant factor in the design of a successful lighting system. Color and texture of a material affect its reflectance. Light colors and glossy finishes have a higher reflectance than dark colors and rough finishes. Therefore, for brightness balance suitable for reading and writing, careful attention should be paid to the colors and textures of walls, floors and furniture.

Painting the ceiling and upper side walls white is an efficient use of light. Where the luminaires direct most of the light downward, as in typical recessed systems, the brightness of the upper walls and ceiling depends entirely on light reflected from the lower walls, floor and furniture. In such installations, the ceiling will look dark unless the floor reflectance is higher than normal. A dark carpet may be a poor choice with a lighting system of this type. Chalkboards should have a reflectance of at least 25 to 30 percent. If a dark-colored chalkboard is large enough to affect adaptation, supplementary light must be provided to bring the brightness to at least one-third task brightness. This adjustment also will increase the visibility of material on the board. Tackboards adjacent to chalkboards should have similar reflectance values.

Contrast rendition and veiling reflections. It has been found that overhead lighting with a heavy downward component causes a serious loss of visibility due to veiling reflections. This phenomenon, which causes a loss in contrast, is produced by the reflection of light from the lines and surfaces that make up the task. Surfaces with high gloss finishes will have more veiling reflections and thus are subject to higher contrast loss than are matte finishes. Reduction of downward components and introduction of light from ceiling and wall areas at an angle to

the task create a uniformly light hemisphere over the task, which is ideal. Large areas of low brightness are therefore more desirable than small areas of high brightness. Ceilings and side walls should have high reflectance and light should be directed toward these surfaces to improve the brightness balance and contrast rendition in the task. Wall brightness is particularly important so that all the light on the task does not come from overhead, producing veiling reflections.

Correction of veiling reflections and the consequent loss of contrast can be accomplished by a qualitative change in the lighting system—in other words, redirect, rearrange and redesign the light sources. Another approach, which is expensive in terms of long-range energy consumption, is to increase the illumination level. To compensate for each one percent contrast loss requires a 15 percent increase in the illumination level. This figure is an indisputable argument for thoughtful, knowledgeable lighting design.

School lighting and flexibility. School lighting systems must be flexible. Illumination must be responsive to the needs of various program activities, to changing spaces, and to a broader range in the age of the users.

The current expanding use of audio-visual learning aids such as computers, teaching machines, television and film projectors poses a new set of requirements in school lighting. Not only must luminaires provide effective, comfortable and accurate visibility for traditional educational activities, but they must be able to accommodate use of these specialized devices.

In flexible and open space facilities, people move around and room sizes and shapes are modified. Lighting systems must be able to adjust to this fluidity of people and spaces. Obviously this adaptability requirement presents a challenging design problem.

With extended use of the school and the growth of community/school programs, the age range of school users has expanded. The necessity for accommodating persons of many ages has suggested that lighting standards based on the needs of children and younger adults should be reexamined in light of an older group of users.

Illumination and energy use. As was mentioned earlier, not all lighting systems use energy efficiently. Poorly designed systems may overlight an environment or may create inadequate levels of glare-free illumination relative to energy consumed. It has been demonstrated that only 6 percent of the energy

used by typical illuminating systems is converted into useful light for comfortable, efficient seeing. The rest often becomes heat that is costly to eliminate.

A primary obligation of the planner is to encourage the use of illuminating systems that are both effective and efficient. Responsible energy use can be encouraged by insistence on proper reflectances and finishes of major interior surfaces and furnishings, intelligently designed switching patterns, fluorescent lamps that use less energy than filament lamps for equal output, heat transfer luminaires and the turning off of unneeded lights. Some educational systems are starting to install computerized energy systems to make sure lighting is used efficiently.

Lighting and aesthetics. Lighting does much more than make objects visible—it is largely responsible for the ambience of a room. No attempt by students and teachers to create a warm, comfortable, pleasing environment will prevail against the relentless brilliance of bare fluorescent tubes. It is imperative that effective, economical and energy-conscious lighting be provided that is also pleasing to the users. When the designers exhibit no concern for human needs, the users either suffer or devise their own relief, usually in the form of incandescent lamps in reading corners where students can occasionally enjoy a warm glow.

The choice does not have to be between aesthetics and effectiveness. A creative, intelligent lighting designer can provide both.

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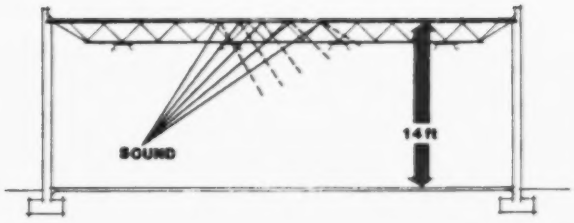
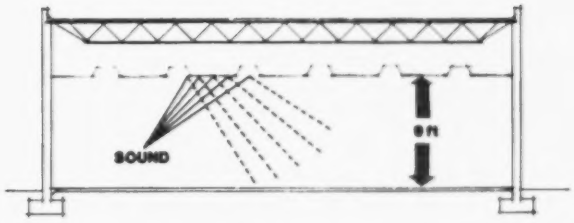


CONVENTIONAL



Courtesy: Rowe-Holmes Assoc. Architects

Acoustics

Designing a good acoustical environment in an educational facility requires the solution of two problems: (1) controlling sound within a particular space so that sound that is to be heard can be heard well, and (2) preventing the intrusion of unwanted sounds from outside the space.

Acoustics are affected by the use of the space, its size and shape, its relationship to other spaces and activities, its location within the school building, and its proximity to sound-producing objects on or adjacent to the school site (traffic noise, for instance). Planners should carefully consider each of these factors during the initial planning stages because expensive surface treatment will be needed later to compensate for oversight or poor judgment. For example, placing general learning spaces within hearing distance of food preparation or industrial arts areas will create flagrant and unnecessary conflicts that may be difficult to correct and impossible to live with.

Although the creation of a desirable acoustical situation requires the expertise of an acoustical engineer, there are some aspects of the problem with which the planner should be familiar.

Acoustical basics. Generally, sound radiates from its source in spherical, expanding waves. It travels through solid substances as well as air. The transfer of sound through a wall, for instance, is accomplished by diaphragmatic action between the two surfaces of the wall. Vibrations are carried from one surface to the other by the structural members to which the wall is attached. Upon encountering a barrier, part of the sound energy is absorbed and the remainder is reflected. The reflected sound reverberates until the sound energy is dissipated. The length of reverberation time is affected by the sound-absorbing/reflecting qualities of the surfaces of the space in which the sound originates. Hard surfaces tend to reflect sound. Soft surfaces tend to absorb sound.

Acoustical treatment attempts to enhance wanted sound and to impede unwanted sound. Its success depends on the types of materials with which a space is surfaced, the size and the shape of the space, and the ability of the barrier to reduce undesirable noise transmitted from outside the space. The effectiveness of a barrier in accomplishing acoustical separation of spaces is influenced by its composition and air tightness. Because there is no such thing as a completely soundproof wall, door or window, such barriers only reduce intruding sound to a point of minimal interference. The intensity of the intruding sound dictates the degree of sound insulation that is necessary.

Transmission loss is that portion of an external sound that is lost in traveling through a barrier such as a wall, door or window. It is usually measured in the number of decibels a sound is reduced by the transmission resistance of the barrier.

Noise reduction in a given space, while it involves transmission loss, is also affected by the area of the boundary between adjoining spaces and the reverberant condition of the space itself.

Treatment of a room to accomplish sound absorption does not affect the original power of the sound. Instead, it prevents the sound from reflecting repeatedly or reverberating. The reverberation sound is retained in the room. The length of retention is related to the original power of the sound, the absorption, characteristics of the space, and the size of the space. Accumulating, retained sounds can create an undesirable noise factor in general learning spaces. Prolonged reverberance is also

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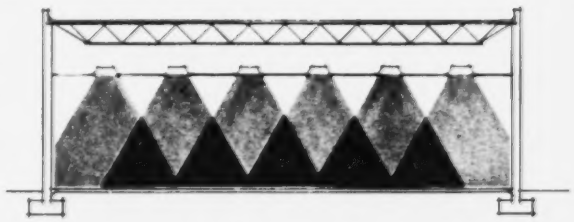

Courtesy: Rowe-Holmes Assoc. Architects

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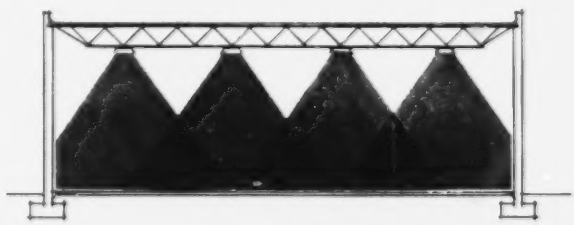


Courtesy: Rowe-Holmes Assoc., Architects

objectionable because it makes speech unintelligible and interferes with communication.

A space in which sound is reverberant is described as a live space. While a live environment is not suitable for general classroom or learning spaces, it is beneficial in other areas, for instance, music rooms.

Background noise consists of sounds originating both within and outside a given space. Coughing, footsteps, chairs scraping on floors, water moving through pipes, and the hum of ventilating systems are some components of background noise. These sounds may reach a listener through walls, doors, windows, and from adjoining spaces not separated by a barrier. Although it has been a standard goal in school design to reduce or eliminate all background noise and achieve a high degree of quiet, it has been found that a certain type of background noise is not undesirable. When intruding noise is general, a vague hum, it is not distracting. The level of sound, then, is to a certain extent not so important as its character. A degree of generalized background noise is actually beneficial in that it masks objectionable sounds within the space. It has been clearly demonstrated that silence is not a necessary condition of effective work, but that sounds exceeding the general tenor of background noise—like intelligible speech from another area—are disruptive.

In normal human hearing, sensitivity varies with pitch. The human ear is least perceptive of low-pitch sound and most sensitive in the middle ranges, with sensitivity tapering off and gradually disappearing as the pitch becomes higher. Obviously, a realistic approach to acoustical problems, whether the objective is the reduction of unwanted sound or the improvement of hearing perception of wanted sound, should be based on sound characteristics. Decibel levels based on sound pressure alone often are misleading. Equal decibel levels related to sound pressures are not equal levels where there are different pitches or frequencies involved.

Actually, effective acoustical design must be predicated upon sound as experienced rather than upon sound as measured. The term most closely related to this viewpoint is loudness. Loudness is related to sound pressure, but it is not directly proportional to it. Loudness is a function of both sound pressure and pitch considered simultaneously.

It is from a consideration of experienced sound that solutions of acoustical problems in schools must proceed. There is no reason to intercept or reduce a sound that cannot be heard. Except at extremely high-frequency levels rarely experienced in school situations, sound does not have any direct, detri-

mental physical effect on human beings. Persistent, unwanted sounds, however, may be distracting and annoying, and may cause a loss of learning.

Sound is a negative influence when it hinders verbal communication and creates a need for talking loudly. Such competition may produce tension and fatigue.

Acoustical objectives. The usual educational acoustical problem requires several types of corrective steps. These include: (1) use of effective sound insulation where desired, (2) creation of optimal reverberant conditions in all school activity areas, (3) elimination or reduction of sound interference from external sources, (4) reduction of unwanted sound, both in spaces where quiet is desired and in spaces through which unwanted sound may travel to quiet areas.

The objective in acoustic design is to secure the desired hearing and speaking conditions for learning at the lowest possible cost in view of such attendant circumstances as the overall building design, desired surface finishes, upkeep, maintenance, resistance to damage and wear, and aesthetic requirements.

A simplified statement of the basic need in acoustic design is: sound reverberation within each teaching-learning area is a larger concern in good acoustic design than the separation of sound between areas. The period of reverberation in each space controls the degree of liveness in that space. The reverberation time, or liveness within a given space, controls the clearness of communication by sound within that space. If communication by sound is clear and easy within a space, unwanted sound from outside the space may be greater without interfering with communication and comfort.

It is obvious, therefore, that acoustical engineering should become a serious part of the design of all teaching-learning spaces. It is also apparent that old cliches about methods of sound control and projection and the degree and type acceptable to building occupants should be reexamined in terms of current educational program trends and emerging school building design. Certainly the acoustical engineer must be both an early and a continuing planning professional member of the school building architectural design team.

Zoning of sound. Zoning as related to sound engineering revolves about the basic premise that prevention is better than correction.

Every effort should be made to acquire a site that has a relatively low ambient noise level. If possible,

the school should be located at some distance from arterial streets and roads, railroads, airplane flight patterns, and other types of noise. Noisy sites must be used when necessary but greater sound interception in the buildings' exterior walls must be provided. Even somewhat remote locations (especially those near highways, railroads, airfields and industrial plants) can be noisy.

It is advisable to locate noisy activities nearest the outside noise source. In this way, spaces housing noisier activities can shield quiet activities. This type of protection can be augmented by substituting turf, gardens and ground-covering for hard paving. The planting of trees, bushes and shrubs on and around the site will also reduce noise.

In planning a school, it is important to group noisy activities together. Thus, playgrounds, gymnasiums, and shops can be located near each other. Administrative offices, library, and general learning spaces can be in a quiet zone removed from the noisy activity area.

If activities with different noise levels are not adequately separated by space, it will be necessary to physically intercept sound to prevent conflict.

Application of acoustical materials. Conventional acoustical materials for noise reduction and reverberation control usually have been applied to the ceiling. Although this is a widespread practice, instrument tests have demonstrated that it alone is not totally effective. Flat acoustical ceilings have been credited with unrealistic absorption capabilities. Also, little consideration has been given to how far reflected sound must travel and what diffusing obstacles might lie in its path. With the application of carpeting to school building floors, an important acoustical material has become available to the school designer. Carpeting has a significant advantage over most other acoustical materials in that it prevents as well as absorbs unwanted sound. By eliminating many floor level noises such as scraping chairs and shuffling feet and absorbing disturbing sounds originating from other sources, carpeting contributes to good hearing and speaking conditions in the classrooms and hallways.

Sound and open space schools. Designing proper acoustical environments in schools has become a matter of increasing importance—and some controversy—with the advent of more open space planning. Buildings that are flexible and adaptable, and that permit flow between small and large spaces, and quiet and noisy areas, have raised acoustical issues that must be resolved. Providing acoustical separation between activities and groups

of people who are not separated by a wall and determining the least amount of acoustical separation that allows persons—either alone or in groups—to work and communicate effectively are the new challenges. Open space planning also has raised some new questions: What constitutes an objectionable noise? What sounds are tolerable and do not interfere?

The degree of quiet that was expected in enclosed classrooms is neither desirable nor possible in open space schools. Low level background noise of a general nature is normally not distracting. Therefore, much of the resistance to open space based on the negative effects of sound transmission is a matter of personal taste and habit rather than demonstrable negative effect.

Noise reduction in open space schools can be accomplished by several means. The most obvious is the grouping of noise-producing activities in enclosed spaces away from the general learning and quiet spaces. Carpeting is an essential component of acoustical design of open spaces.

Acoustical separation of spaces can be accomplished with several types of physical barriers. Operable partitions can be moved, folded and unfolded at will to divide spaces. Some operate on fixed tracks; others are more flexible. Improvements have been made in the acoustical quality of these barriers. The selection of this equipment should involve a consideration of performance capability, compliance with operation specifications, cost, quality, installation and service. Because these partitions are expensive, they should be installed only where essential.

Demountable partitions can be erected and removed to accommodate changes in space requirements. They are not like operable partitions ordinarily used for hourly or daily changes, although some types can be easily moved. Demountable partitions can be installed in a completely finished room without changes to the structure, after the floor covering and ceilings have been installed. Unless careful consideration is given to the space above the ceiling, sound leaks may occur between divided spaces.

Storage cabinets, bookcases and other furniture can be used as visual barriers although they are not capable of providing a high degree of sound isolation.

Free-standing screens provide some acoustical separation and are easily moved.

Sound and enclosed spaces. Enclosed classrooms should receive acoustical treatment that is approp-

riate for the activities they will house. Specific information regarding acoustical needs of various learning and auxiliary spaces can be found in Units G and H. Since corridors and toilets were not discussed in these earlier Units, some mention should be made regarding them here.

Unless adequate noise reduction treatment is provided in corridors, they can act as communication channels conveying sound through a building. Thus, unwanted sound from a noisy activity can be conducted to an area where quiet is desired. Noise reduction treatment that will minimize locker noise also is advisable. Although the ceilings of passageways ordinarily are acoustically treated, in most cases the application of acoustical materials to one boundary is insufficient. Even covered passageways that are open to the outdoors on one or two sides require acoustical treatment because of the flutter echo generated between sidewalks and ceiling. Proper attention to both floor and ceiling surfaces is essential.

Hard, impervious surfaces are often specified in lavatories and toilets. Because such materials conflict with desirable acoustical treatment, these spaces need special attention to reduce noise and create an adequate sound barrier between adjacent spaces.

The Thermal Environment

There is more to the thermal environment of a school building than the HVAC system operating within it. Air temperature and quality are determined by a number of interrelated factors, including:

- the number, size, insulative qualities and orientation of windows
- the quality and extent of insulation
- the quality of sealing
- the color of the building shell
- the use of interior and exterior shading devices
- the climate
- building orientation
- landscaping—trees, site grading, etc.
- the number of building occupants and their activities
- the lighting system
- the efficiency of mechanical and electrical systems
- other equipment operating and generating heat

In designing a school building or planning a renovation to provide thermal comfort, it is necessary to consider all of the above factors with respect to their cost (both initial and life), their effect on energy use, and their impact on the perceptions and behaviors of the building users. This delicate task often

involves balancing one need or priority against another and selecting the most advantageous alternative. Compromise of this type is particularly necessary in locations where seasonal temperature changes are extreme and designing for warmth in the winter and cooling in the summer is necessary.

Minimizing energy use. An important goal in creating a thermal environment that does not make excessive energy demands is to minimize uncontrolled or unwanted heat transfer through the building shell. This means that efforts should be made through effective insulation, thorough sealing, careful window placement and building orientation to prevent heat loss from a space being heated and the admission of heat into a space being cooled. By reducing heat transfer of these types, the load on the HVAC system may be kept at a reasonable level and unnecessary energy use decreased.

Planners and purchasers of equipment for heating, ventilating and cooling educational facilities should specify those systems that use energy conservatively and that can be operated efficiently by operations and maintenance personnel. Some educational systems are installing computer monitoring systems to better control energy usage and thus reduce unnecessary costs. As with all items to be designed or purchased for educational facilities, it is imperative that life-costs of the equipment be calculated and analyzed. (See Units J and K for discussions of benefit-cost analysis and life-cycle costing.)

New demands. Four developments have influenced the design of heating, ventilating and air conditioning systems for educational facilities today:

- the open space plan
- the cost of energy and the need for national energy conservation
- extended community use of educational facilities
- the pressure for economy

Rather recent architectural freedom in the design of educational facilities has affected heating, cooling and ventilation. Large interior spaces with or without operable and demountable walls have allowed flexibility in educational programming. They have, at the same time, dramatically increased problems of heating and cooling—problems compounded by the increased use of electronic media and computer instruction, variety in the shapes and sizes of learning spaces, flexibility, and interchangeability in functions. When rooms and spaces were of fixed dimension, it was a relatively simple matter for the mechanical designer to select a system that could

heat, cool or ventilate a given space. Specifications were based on the size, occupancy and a predetermined function of the space.

Open space and thermal equipment. It is a different matter to design for adequate comfort in a space where none of the above conditions are constant. Large, open spaces do not permit individual control of temperature. Operable walls, demountable partitions and open, unobstructed spaces have greatly reduced wall space where distribution equipment and control mechanisms can be installed. Consequently, ceiling distribution and rooftop placement of heating and cooling equipment have become common practice. As a further refinement, much has been done in the area of combined heating/cooling and lighting systems in an overall ceiling assembly. Some of these systems are based on a module of air/light distribution that covers a given area of floor space regardless of partition location. While a number of these systems are proprietary, many architects and engineers have designed satisfactory component systems that are competitive with packaged systems.

Cooling educational facilities. The increased use of cooling in school buildings has become necessary with open space planning. Air conditioning is also necessary where the climate demands or where schools are used all year. Ongoing developments in the field of heat recovery or reclamation have sought to balance costs and conserve energy by storing waste heat from integrated lighting and cooling systems for reuse as heating sources. When cooling of the school environment operates as an inseparable, productive component in a heating/cooling cycle, it cannot be viewed strictly as an amenity.

Energy-conscious design. Many innovations have already appeared in the field of heating and cooling. More are needed, particularly research and experimentation related to new energy sources (especially solar energy) and their application to the school environment, refinement of efficient mechanical systems, and architectural design that supports such systems. Schools that demonstrate a respect for the natural environment are both desirable and necessary.

Facility planners and designers should seek the technical assistance of engineers who specialize in the thermal environment and should attend to new developments in architecture and engineering that allow conservative energy use.

J

EQUIPPING THE FACILITY

Name of School: Ogawa Elementary School

Owner/School District: Higashiuramachi, AICHI Prefecture

Architect: Tanaka-Nishino Architects and Engineers

Interior Design:

Photo: Satoru Nagasawa

Data:
Building Area: 7487 sq.m.
Enrollment: 900
Construction Cost: ¥870,000,000 (at that time)
Date of Completion: Oct. 1978

Note:
Cafeteria and Multi-Purpose Hall

Name of School: **Kaseda Elementary School**

Owner/School District: Kaseda-shi(city), Kagoshima Pref.

Architect: Ishimoto Architectural Firm, Inc.

Interior Design:

Photo: S. Nagasawa

Data:
Building Area: 6148 sq.m.
Enrollment: 770
Construction Cost:
Date of Completion: March, 1985

Note:
Library Resource Centre

The familiar image of Mark Hopkins sitting on the end of a log busily engaged in recitation is representative of the commonly held conception of the role of furniture in schools. If tables and chairs can hold people, paper or materials related to instruction, they are considered adequate. This limited reasoning gives little or no attention to the proposition that furniture and equipment play an indispensable part in providing a creative environment for learning. The current demands for varying sized spaces to accommodate varying sized groups of students would suggest the need for differing types of furniture for differing instructional needs. The same is true for the equipment necessary to serve the instructional program. The main objective in equipping a facility is the enhancement of the educational program. The quality of furniture and equipment could well be proportionate to the quality of teaching and learning that will be possible.

The selection of appropriate movable, fixed and built-in furnishings and equipment begins with the appointment of a selection committee composed of users, designers, and the architect under the direction of the professional school planner. The responsibilities of this committee will include studying the curriculum to determine the types of furniture and equipment needed, determining the standard of quality to form the base for developing specifications, evaluating competitive bids, and making recommendations for purchase.

A successful selection process will depend on an understanding of the selection criteria, on the timing of planning for furniture and equipment, and on the adequacy of the budget. The committee will need to know the basic categories of furnishings, the manufacturing process, and the procedures for writing specifications and analyzing bids.

Criteria

Basic criteria to guide the selection process include:

Appearance. Items of furniture should harmonize with the architectural surroundings. They should be attractive in terms of color, form and texture, and should contribute to the beauty of the environment.

Flexibility. Furniture and equipment should not only accommodate current needs but also support evolving programmatic needs. Movability, adjustability, and multi-functionalism are important characteristics. It is critical that the users — teachers, students, administrators — be able to modify the environment. When equipment can be disassembled, rearranged, expanded, reduced or otherwise changed to suit changing activities and needs, an important requirement has been satisfied.

Safety. Furniture and equipment should be fire retardant and should not produce toxic gases or smoke should they burn. Items should be composed of non-allergenic substances. They should not have dangerous protrusions, nor should they easily pinch, tip or collapse. Corners, edges and hardware should be designed to prevent injury. All edges should be rounded and, where possible, composed of or covered with resilient material. Where the young user could lick or chew objects, materials and finishes should be non-toxic.

Durability. To insure durability, items should be tested under conditions similar to those in which they will be used. Manufacturers should be asked to provide samples. Remember that furnishings may be used for purposes other than those for which they were purchased or intended.

Maintenance. Low maintenance is extremely important. Replacement parts should be easily obtainable.

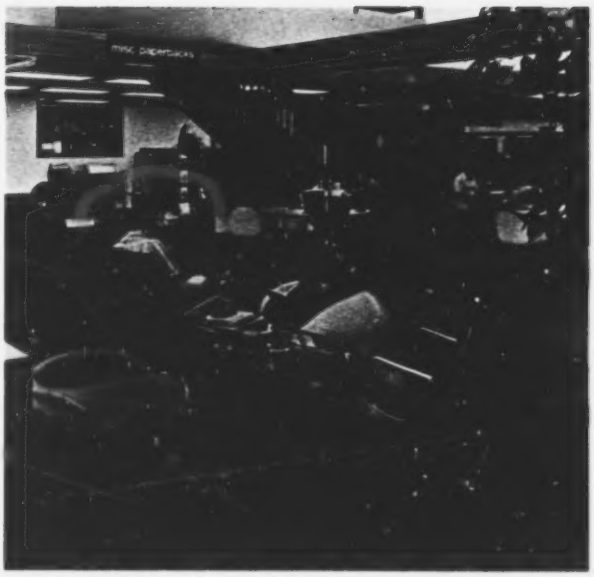
Comfort. Comfort of the users should be considered. Scale, texture, form, light reflectance, and adjustability are important considerations.

Building codes. Do all items adhere to applicable building codes? Many states have codes requiring minimum standards of design.

Guarantees. Terms of furniture and equipment guarantees will vary and should be checked with the manufacturer. Some items may be guaranteed for the life of the building; other items may carry no guarantee at all. Most items carry at least a one-year guarantee against defects in workmanship and materials.

Cost. Purchases should never be based solely on lowest price. If an inexpensive item is not durable, does not fulfill educational requirements, lacks safety features, or does not meet other standards, it will be costly later. The long-term expense of operating and maintaining furniture and equipment is more critical than their initial cost. The original cost plus the cost of ownership should be considered. The most efficient product and the one that can be maintained at less cost is ultimately less costly.

Services of the manufacturer and/or distributor. Customer service provided by the manufacturer and/or distributor is an important consideration. Willingness to repair or replace faulty items, ability to meet delivery dates, quality of installation and clean-up, and willingness to modify standard products when required on large orders should be examined. The supplier should be close enough to the school to provide service in a reasonable amount of time. If there is no prior experience with



Parkway North Sr. H.S., Saur/Obrock Design Associates, Architects

the supplier, references from other customers should be obtained.

Timing

Timing the acquisition of furniture and equipment is important so that sufficient funds can be budgeted and satisfactory delivery schedules can be arranged. When bond issues are called for voter approval, the precise costs of the new or renovated facilities are not known. In too many cases, building plans are completed and construction budgets are finalized before furnishings and equipment are considered. This is too late. It has been established that there is a direct correlation between effective instructional systems and the kind and quality of furniture and equipment. Budgets for these items must be established concurrent with the construction budget to insure proper equity.

This phase of the planning process cannot be overstressed. Obsolete or insufficient furnishings and equipment in a new, well planned and designed school can destroy a positive impact on users and the instructional program. Proper and timely planning can insure a successful conclusion.

Delivery schedules of manufacturers are another consideration calling for timely planning. Deliveries may vary from two or more weeks for desks or chairs to two or more years for some specialized equipment. Orders should be timed so that deliveries coincide with the construction and occupancy schedule.

Budgets

The budget for furnishings will vary with the function of the facility. Elementary and secondary schools will normally require from 15% to 25% of the projected construction budget. Specialized buildings such as university libraries may require up to 50%. Budgets for major research facilities may well exceed the cost of building construction. The development of the furnishings budget early in the planning is imperative.

Equipping Classrooms

Classroom furniture and equipment falls into these four basic categories: tables; desks; chairs; and cabinets and dividers.

Tables. Tables are produced in four basic shapes: the rectangle, the square, the circle and the trapezoid. Rectangular and square tables are traditional and are normally used in areas where they can be lined in rows, for example, a library or study area. Each table can accommodate four or more students depending on its size. These types of tables do not lend themselves to grouping in shapes other than

Name of School: Iwae Elementary School

Owner/School District: Miharu-machi(town), FUKUSHIMA Prefecture

Architect: Kazumasa Yamashita Architect and Associates.

Interior Design:

Photo: S. Nagasawa

Data:
Building Area: 2650 sq.M.
Enrollment: 250
Construction Cost: Y412,000,000
Date of Completion: March, 1985

Note:
Learning Center

their own. The round table, which must be used individually, requires less floor area and succeeds in providing a seating arrangement that encourages cooperation. Adaptations are available in half-round forms. The trapezoidal shape permits a variety of grouping possibilities, which offers more flexibility for modern instructional programs.

Tables were once considered necessary only for areas where large groups of students would be accommodated, i.e., in libraries and study areas. Creative teachers are now discovering that multiple student tables can make a significant contribution to the instructional program. The use of tables can encourage discussion, participation and cooperation, while giving students more working space.

Desks. Student desks have evolved from those arranged in rows and bolted to the floor to those arranged in rows but not bolted to the floor. The flexibility of these individual stations is negligible; they offer little more than their anchored predecessors. These desks are found in two basic models, the chair-desk and the desk with chair.

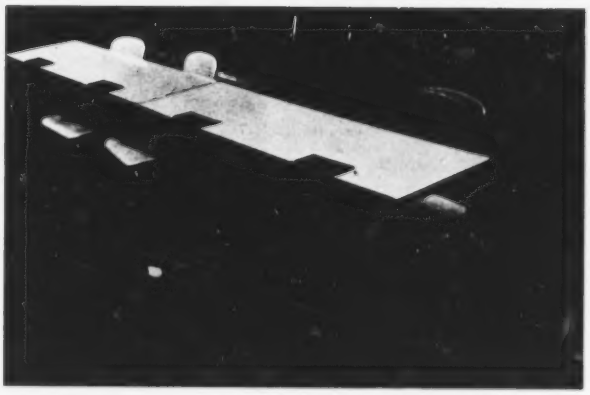
The chair-desk is a combination of a seat and a writing surface. The classic and thoroughly familiar style is the arm chair with the small writing space on the right or left side. Books and materials are stored under the seat or in a wire rack on the side or back of the chair. This particular chair is not appropriate for a modern classroom. Adaptations featuring full writing surfaces (18" x 20" or larger) are more appropriate for extended periods of study.

The desk with chair is a modification of the chair-desk. It is characterized by a full rectangular, square or trapezoidal writing surface with storage space on either the right or left sides, under the top, or in a well reached by lifting the top. The student chair is not attached. The desk with chair offers more freedom in grouping than the chair-desk. A large writing surface should be a primary specification.

Chairs. Student chairs are available in two basic styles, a molded one-piece shell and a seat with a separate backrest. Backrests are either fixed or adjustable, but the latter feature adds to the cost of the chair. It is an important consideration in comfort, however, and should receive attention. The type of chair selected should encourage proper posture of students who must sit for extended periods of time.

Cabinets and dividers. The use of movable cabinets and panel dividers is a direct result of the trend toward open space for instruction. These units often replace traditional room arrangements as "containers" of education. Their importance in meeting the

Chairs/desks, Ohio State University, Columbus, OH.



Chairs/desks, Ohio State University, Columbus, OH.

demands of this role, coupled with the lack of available research, necessitates careful evaluation.

Using the typical 3' x 5' x 5' storage cabinet on casters as a movable divider may not be practical. The standard cabinet usually weighs approximately 75 to 100 pounds when empty, and up to 300 pounds when filled with paper and books. Moving this much weight is usually beyond the capabilities of most teachers or students, thus these dividers often become permanently placed. Careful attention should be given to the selection of units when ease of movement is desired.

Lightweight panels on casters featuring bulletin board and chalk board surfaces are serving more and more classrooms as space dividers. Their ease and rapidity of movement make them a highly desirable consideration.

Equipment for classrooms ranges from pencil sharpeners to microcomputers. The sophistication of these kinds of items varies widely but all require examination in relation to the quality of program desired and the wise expenditure of funds. Manufacturers' specifications and specialists in technology should be consulted.

OSU Hexapod Walking Machine Lab, Columbus, OH.

Robotics Welding Lab, OSU, Columbus, OH.

Equipping Laboratories, Shops and Specialized Teaching Areas

These areas include science, language, mathematics and social science laboratories, vocational shops, home economics facilities, and music and art studios. The furniture for these areas is specially designed to accommodate curricular innovations while meeting safety standards. Equipment often comes as a part of specific furniture items or is designed to coordinate in meeting curriculum requirements.

Many of these items are produced by specialty companies. The school planning specialist can help in determining specifications.

Equipping Offices

Contemporary office design ranges from the traditional desk, chair, credenza and side chair to modular self-contained units with privacy panels. A wide choice of wood and steel models is available in all price ranges.

The selection of office equipment will depend on its function. Specialists should be consulted on the availability of built-in or portable items and on the desired quality.

Equipping Resident Centers

Today's dormitories bear little resemblance to the one- or two-student room arrangements of past

years. Student residence halls are now designed to accommodate a wide variety of living, learning and recreational styles. Furniture and equipment needs range from beds and dressers to sofas and computer terminals. Again, specialists in these areas should be consulted to obtain the latest information on product availability. The committee should be particularly careful to insure that current trends in student housing are understood and accommodated.

Equipping Research Centers

These facilities present problems related to their unique structural and utility requirements. The architect and engineer must work closely with users and manufacturers to insure the necessary detail work. The professional school planner can serve as a coordinator in these special cases.

Equipping Libraries/Media Centers

If libraries are storehouses of the world's ideas, and if the role of education is to bring students and ideas together, then the library-resource center might well be the most important space for teaching and learning. Furniture and equipment for this area should be selected with this in mind.

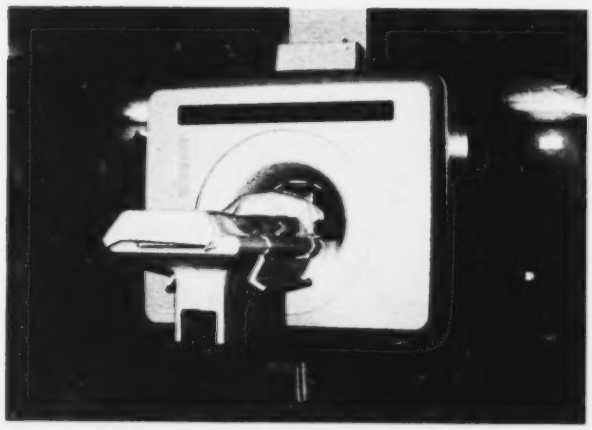
In addition to seating, shelving and file space, the library will require a variety of electronic, computer and audio-visual equipment. A specialist in library design and function can recommend the latest in technology with the flexibility to accommodate certain change and refinements.

Equipping Food Service Areas

The complexity of food service furnishings ranges from one or two vending machines to full-service cafeterias to accommodate thousands of students. Considerations must include commercial food preparation and serving equipment, beverage dispensers, and tables and chairs. New developments in food technology and their implications for the future should be studied. The preparation of nutritious, appealing food dishes at the most efficient unit costs is the goal. The expertise of specialists in this area will be essential in the planning and selection process.

Equipping Maintenance and Plant Support Facilities

Large, self-contained educational systems such as universities and large school districts must provide a variety of services, each requiring specialized furniture and equipment. These support facilities include electrical and plumbing shops, auto and bus repair and maintenance facilities, refuse collection systems and security stations. Planning for equip-



OSU Magnetic Resonance Imaging System Cryogenic Magnet, Columbus, OH.

OSU patient about to use Cryogenic Magnet, Columbus, OH.

OSU Computer Center for Cryogenic Magnet, Columbus, OH.

Name of School: **Kaseda Elementary School**
Owner/School District: Kaseda-shi (city), Kagoshima Pref.
Architect: Ishimoto Architecture Firm, Inc.
Interior Design:
Photo: S. Nagasawa
Data:
Building Area: 6148 sq. m.
Enrollment: 770
Construction Cost:
Date of Completion: March, 1985
Note:
Outdoor Cafeteria

ping these areas is important if maximum services are to be achieved.

Equipping Auditoria and Performance Studios

These specialized areas have unique requirements, including lighting, acoustics, seating, and sophisticated stage riggings for props and curtains. Because these areas are highly visible, they must be technically correct and aesthetically pleasing. The coordination of specialists, manufacturers, architects and engineers and contractors is essential.

Quality Factors

Materials used in the manufacture of furniture include steel, wood, laminates, fiberglass and plastics. The manufacturing process is similar regardless of the manufacturer; the differences appear in the quality of the basic materials, the care exercised by workers at strategic points of manufacture, and the finishing process.These differences are reflected in the price of the item. Accepting a product lower in cost and quality could result in a higher net cost due to continuous maintenance and limited longevity.

Frames. The steel used in frames for chairs and in legs for tables is either round or square. The frames begin as straight pieces of pipe that are swaged by machines to the desired sizes and taper. They then pass to bending machines for shaping. Welding is done by machine or by assembly line workers. Hand welding is usually associated with higher quality furniture.

The completed frames, swinging from overhead conveyors, move from the welding area to the paint chamber. The frames are rotated and magnetized on entering the chamber. As they pass through, a fine mist of paint is sprayed into the chamber, completely covering each of the frames. The unequal distribution of electrons and protons resulting from the magnetic force insures the attraction of the paint to the metal. The painted frames then move through a drying cycle.

Finishes. Two types of paint are used: enamel and epoxy. Enamel is the least expensive of the two. An investigation of chairs with this type of paint reveals that chipping and scratching will occur with use. The epoxy resists chipping and scratching and will retain its appearance longer. This difference is one of the variables to be considered in the selection of the desired quality.

Wood. The wood used in table or desk tops is of two basic types. One is a solid-core pressed board ranging in thickness from one-half to one-and-three-fourths to two inches. The other is a hollow core,

which consists of a frame in the desired shape and size. A sheet of plywood is placed on one side and a cardboard honeycomb is placed in the frame. Another sheet of plyboard is then placed over this to form the top. The hollow core has the obvious advantage of less weight, but at the same time it is not as durable. The weight factor should be a consideration, however, where ease of movement is important, such as in early learning and primary classrooms.

Tops. The laminate found on table and desk tops and used to cover cabinets and other items is a plastic material glued, under extreme heat and pressure, to the surface of the wood. Laminates come in a variety of colors and patterns and are highly desirable for their ease of cleaning and resistance to liquids.

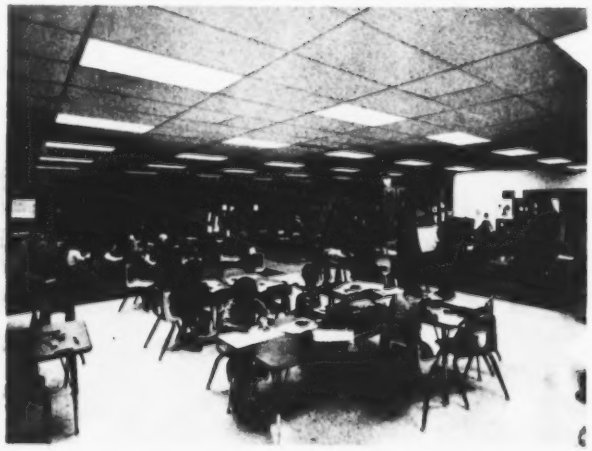
Seating materials. The materials used in the manufacture of seats for chairs are plastic, fiberglass and wood.

Liquid plastic is injected into molds and subjected to heat and pressure to form shells, seats and backs. This process is less expensive than others and results in a basic chair at a lower unit cost. Its major advantage is the flexibility of the materials that permits a slight movement as the occupant shifts positions. This provides a degree of comfort. The porous or rough surface of the material is necessary to hide lines formed by underneath supporting ribs. This type of surface collects dirt easily and is difficult to clean.

A new molded plastic featuring a smooth surface has been introduced. This product retains the advantages of the traditional plastic seat while reducing the disadvantages. The future development and improvement of this material will have a decided impact on the industry.

Fiberglass is formed under extreme heat and pressure and is a durable and attractive product. Fiberglass seats feature a smooth, nonporous surface that is easily cleaned and that retains a satisfactory appearance. While it is not impervious to vandalism, it is a durable material under normal use.

The most desirable wooden seats for chairs are thin plys bound by glue, heat and pressure and molded to the desired shape. They are usually varnished or covered with a plastic laminate.



Innis Elementary School; Sounik/Eller/Martin, Architects

The Bid or Tender Analysis and Purchase

The system used for acquiring the desired furniture and equipment involves the following: (1) preparing written specifications for bidding, (2) announcing and receiving bids, (3) analyzing bids or tenders and

St. Francis Children's Activity & Achievement Center, Fox Point, WI.

(4) making recommendations to the governing board for purchase. Each step is important to the outcome and demands careful consideration.

The selection of furniture and equipment to serve as models for preparing specifications is the first task to face the committee. Samples must be examined and the various points of comparison must be considered. This process requires objective analysis and the ability to discern the relationship of price, quality and function. Some questions to be asked include:

1. Does the item meet the unique need of a planned instructional program?
2. Is the quality of manufacture adequate to insure the wise expenditure of funds?
3. Will the item be sufficiently maintenance-free?
4. Is the price within the budget allocation?

When the selections have been made, detailed written specifications are prepared on each item of furniture and equipment. The specifications should include the necessary data to enable suppliers to bid or tender on specified items or on proposed equals. In some cases, bidders may be asked to submit samples of proposed equals for approval prior to acceptance of bids. The bid form should also contain detailed instructions about delivery and installation.

After tenders have been received and officially opened, the committee must concern itself with the bid analysis. This procedure requires the evaluation of prices to determine the low figure on each specified item, and whether or not items proposed as substitutes qualify as approved equals. The tender analysis is to be prepared in writing. It is a critical phase if full value is to be received and the needs of the instructional program are to be met. Attention to detail is important at this stage of the process. The bid analysis concludes with the committee's recommendation for purchase.

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PROJECT BUDGET AND COST CONTROL

Photo Courtesy Audio Visual Services, Vancouver School Board.

Project Budget and Cost Control

Educational facility planners attempt to develop buildings that represent in value and cost what taxpayers conceptualize as a "good buy." This means a facility that looks good, functions well, is initially affordable, and will have reasonable operational and maintenance costs. In short, the goal is to get the most for the money spent.

Because of the complexity of the planning process and the large numbers and varying roles of the persons involved, there are numerous opportunities for either wasting or saving money. The decision to build sets off a chain of other decisions that have implications for the cost and the effectiveness of the resulting structure, both initially and for the life of the building. Cost is affected during each planning stage—building programming, planning and design, bidding, preparation of contract documents, construction, equipping, operation, maintenance, evaluation, and rehabilitation. Although this sequence of events may span half a century or more, the basic economic success of the project stems from the effectiveness of initial planning and cost consciousness at each stage.

No single decision will result in an economical school building. An efficient HVAC system alone is not the answer; nor are multiple stories, use of natural light, centralized site, and so on. No single planning innovation, structural system, building material, or contractual arrangement will ensure an economical building. Numerous opportunities for economy exist. Consistent attention to these opportunities and well-informed appraisals that consider long-term as well as initial costs will result in true economy.

Because cost control is an intrinsic part of the planning process, it has been a recurrent theme throughout this book. It is therefore strongly recommended that readers re-examine preceding units for information related to cost. The purpose of this unit is to summarize primary cost considerations that have been previously mentioned, to introduce additional information related to economy, and to briefly discuss cost/benefit analysis and life-cycle costing.

Opportunities for Savings

A commitment by boards of education and professional educators to the planning process for a project is essential. Schools represent large investments for every community and need to be planned with intensity. Because opportunities for saving money arise throughout all stages of planning, design, and construction, this section will examine the major opportunities as they chronologically occur.

Use of professional services. An often repeated axiom of school building projects is that good school design results when a thoroughly professional architect gets together with a thoroughly competent owner. The architect should be carefully chosen and should bring to the project both capacity and a willingness to investigate and fulfill the user's needs. The owner and the architect must develop a working relationship characterized by mutual respect and cooperation. The levels of skill, imagination, and intelligence with which each party performs its functions will affect the cost of the project.

Other individuals whose expertise can help to save money are various specialists who are consultants in educational programming, space planning, and site development; in structural, mechanical and electrical engineering; and in acoustics, lighting, furniture and equipment planning. The nature and number of consultants and their fees and responsibilities should be determined at the outset of the project as a means of achieving the most cost-effective facility.

The employment of specialists—in particular, a professional educational facility planner—helps to ensure that the project will benefit from current knowledge and technology, that it will develop smoothly and on time, and that misunderstandings that often result in redesign, rebidding, and delay (all of which are costly) can be avoided. Obviously, a high degree of cooperation is essential for an integrated approach to planning.

Development of educational specifications. Once educational goals for the schools are clearly stated, educational specifications can be written. Educational specifications seek to relate spatial, equipment and special environmental needs, all of which can be assigned a dollar value, to program content and activities. It is essential that the building's users be involved in the preparation of this document and that they be allowed to express their anticipated needs and preferences. Participatory planning will help to prevent the specification of unusable space and unwanted items and the omission of equipment and furnishings. Only by allowing time and resources for thorough and accurate specification preparation can potential economies be realized. Recommendations should be based on suitablility and compatability with the educational program. Cost/benefit analysis is an

important decision making tool which may be employed here.

The development of educational specifications serves another important function related to cost in that it presents an opportunity to develop a consensus about particular facility needs before architectural planning begins and before construction is undertaken. Every change made afterwards may involve additional expense. It is important, therefore, that educational leaders recognize their responsibility for this step.

Sophisticated computer-based tools for determining program requirements have been developed. Simulation techniques allowing the testing of the building program in terms of utilization and efficiency criteria can be implemented. Preperformance testing of this nature may provide economies of important dimension.

Design. The design of a building offers ways to control costs while providing a structure that is both aesthetically pleasing and functional. A compact building can reduce costly exterior walls. The design of a building commensurate with the educational specifications can result in the minimum of square feet being constructed. The building materials, selected from several alternatives, greatly affect total building costs. This list is not exhaustive. An important part of cost control is at the design stage where there are many actions that can control costs. Total and open communication between the owner and design team is essential.

Stock plans. Attempts to reduce facility costs by eliminating professional services through the use of stock plans seldom produce satisfactory results. Because of their inability to respond to unique program needs, stock plans should be avoided. Indeed, dollars saved by eliminating professional services are small compensation when the result is a school building that cannot accommodate the desired program.

Stock plans present the additional problem of often not being adaptable to preferred or available sites. Local preference and pride in design and aesthetic appeal are also factors that have made stock plans unacceptable.

Repeat plans. Repeat plans differ from stock plans in that the repeated plans are those which the owners have judged as desirable after evaluation of an existing building. The use of such plans usually saves some professional fees and results in additional savings since the time spent to develop construction and bid documents is reduced significantly. Costs can be controlled, too, through reusing the furniture and equipment specifications and bid documents.

Site selection and development. The site and its features can significantly affect the cost of construction. Subsoil conditions can affect foundations and drainage, severe topography may require costly site preparation, size may be a determinant in the shape of the building, and the existence of natural vegetation will affect landscape and planting costs. The character of the immediate surroundings can also affect the building costs. For instance, an inexpensive site located beneath a jet air-craft approach may actually be costly in terms of exceptional acoustical barriers required to combat noise. Hidden costs related to all site features must be investigated.

In the urban school setting, imaginative solutions to the use and development of the school site can introduce economies as well as extend the impact of the school and its program. Sharing the school site with other community functions makes good sense, as do joint occupancy situations where the site and/or building are shared by education, commerce, industry, or housing. Not only can such combinations prove economical in terms of land use and construction, but they can also be rendered educationally viable. Finally, the use of air rights above highways, railroad tracks and yards, and other urban elements may provide alternative site locations that otherwise might be prohibitive in cost.

In areas where land appreciation values are high, it may be preferable to acquire school sites in advance of actual need. Early purchase may involve a lower cost. However, land acquisition, whenever undertaken, must be based on solidly researched, accurate projections and careful long-range planning. Site selection and acquisiton should be integrated with other community developments. Coordination can introduce real economies by ensuring that proper utilities, access roads, and services exist; that the school is centrally located; and that sufficient land is available to meet community educational needs. Selecting sites that are very near the population to be served by the school is now of greater importance than ever before. Reduced vehicular transportation will result in savings that are potentially great.

Scheduling. A great deal of time is required for those involved in a building program to reach deci-

sions and complete activities related to programming, planning, preparing drawings and contract documents, securing necessary local and state regulatory agency approval, and bidding of projects. It is necessary to develop a complete and firm timetable for these activities to which all parties must adhere. Each day of delay represents an increase in cost.

A logic network can be used as a scheduling tool. The Critical Path Method (CPM) and the Performance Evaluation and Review Technique (PERT) are two well-known networks that are useful when planning and constructing educational facilities. Both require the identification of tasks and the estimated time to complete each task, and the sequencing of events. Computer application is common.

Building codes. Building codes can sometimes prohibit or restrict the use of new materials and construction techniques that would contribute to efficiency and cost savings. Building codes, zoning ordinances, and other regulations properly exist to maintain health and safety standards and to ensure public welfare. However, their relevancy and validity must be constantly reviewed to avoid the imposition of unnecessary costs on school building construction. School planners and administrators should assume a major responsibility for pointing out instances where building codes unnecessarily subvert school building economies. Through early and effective communication with officials in regulatory agencies, it is often possible to have certain codes and restrictions interpreted and/or waived. Such efforts should produce time and cost savings and, most important, environments that comply with safety standards.

Cost estimates. At various stages in the planning process, cost estimates must be developed by the architect to ensure that the projected costs and the project budget are in agreement. There is far less chance of a budget crisis when the bids come in if checks have been made at several points during planning. These cost estimates should be increasingly thorough and accurate as the design develops. The small additional expense of retaining professional cost estimating services is usually justifiable for owners as well as architects. Also, a contingency cost factor is necessary, but it should not be so high as to encourage frequent change orders during construction. A usual range is three to four percent of construction costs.

Bidding. Clarity of bid documents and time of advertisement will affect costs. Complete and precise contract documents will aid the contractor in making accurate cost estimates. Incomplete and confusing drawings and specifications will sometimes cause the contractor to protect himself from unforeseen costs by adding a substantial contingency figure to his bid. A prebid conference between the architect and competing contractors is a good idea, especially if unusual design or construction practices are to be employed.

Even with complete and clear drawings and specifications, adequate time must be allowed for the contractor to complete his estimate. A rush job opens opportunities for omissions and errors and will not allow sufficient time for obtaining subbids. Adequate time will vary from place to place and may depend upon the amount of other construction out for bid in the area at the time of bidding for the school project.

Bidding should be related to local conditions as well as to the time of the year. Although of less importance now than in the past, construction is still a cyclic business with activity peaking during the spring and summer and slackening in the fall and winter. The time of bids should take advantage of such seasonal changes. Also, local conditions may indicate a favorable or unfavorable time for taking bids—if a larger volume of construction is under way, it may be difficult to interest contractors in developing close bids.

In some areas of the country, the form and number of contracts required for public construction are dictated by law, but, where possible, both the single contract and the multiple contracts systems should be considered. Each should be frequently re-examined for its effect on school costs, particularly with regard to allowing options in the bidding procedure to take full advantage of the prevailing construction climate.

Add and deduct alternates in the bid can result in the owner getting the maximum building for the dollars available. The presence of alternates in a bid document assumes, of course, that cost estimates indicate that all desirable elements of a project may not be affordable. The general conclusion is that an owner most often does not receive full value for the dollar in an add-deduct alternate situation. Well planned, however, they do give some bidding flexibility and make it unnecessary to rebid a complete project. The alternates rather than the whole project can be accepted or rejected.

A recent addition to the bidding process for public projects, including educational facilities, is prebidding or phasing certain elements of the project. Most often, elements that come early in construction are the ones that are prebid or phased. It is common, for example, to bid early for site work, foundations, and steel. This could result in lower prices because of an early bid date. However, as a guard against not having sufficient funds to complete the project, the owner and architect have to make certain that the bids do not exceed the estimates for those portions of the project being prebid.

Construction. It would appear that with competitive bidding and a fixed price contract, the last opportunities for developing economies in the school building process would have been realized by the time construction begins. This is not the case. Construction changes resulting in additional time and expenditures should be avoided and generally can be if programming and planning have been conscientiously carried through. Delays in decisions during the construction can mean money—money for overtime, additional materials, demurrage, and storage—in addition to the frustration of not having the school completed for occupancy as scheduled.

Again, the means for preventing costly changes and delays lies with the contractor, architect, and owner, and the lines of decision making and responsibility among them. For each of these parties, a single point of communication should be designated so that questions can be resolved in a prescribed, straightforward manner without conflicting decisions and opinions.

It is difficult to avoid or deduct change orders at some point in the construction process. But the old adage, that a deduct change order is worth only half what you think it should be and an add change order costs twice what you think it should, is as applicable today as ever. So it is advantageous for all concerned to plan and communicate with the intention of avoiding change orders.

Supervision and inspection are important in terms of coordinating the work of the project and ensuring that permits are issued on time, that shop drawings are checked on time, that decisions as to finishes, colors, and materials are made on time, and that special equipment and casework are on the job at the right time. Good supervision also ensures that if changes do have to be made, they are identified and initiated with the least possible delay and cost. The local school board is advised to retain its own inspector. The cost is minimal in relation to the total project, and the dollar savings usually more than offset the inspector's salary.

Construction and management systems. Owners and architects should be familiar with the cost benefits of project delivery systems such as construction management. CPM and PERT, discussed earlier, are often applied. Design-build, a construction management technique, enables the owner to work with the architect and actually start construction prior to the completion of final design details. Fast-tracking, a similar technique, telescopes the project's time requirements by overlapping various steps in the process of design and construction.

Systems construction, which subdivides the building into massproduced components that can be interfaced, is another alternative capable of cutting costs by reducing construction time and the need for specialized craftsmen on the building site.

Energy-conscious design. An energy-efficient educational facility is the goal of the owner and the architect, and of their engineering consultants. The energy-conscious design of an educational facility includes (a) site selection and the building's orientation on the site; (b) a detailed review of the educational program, the size and volume of spaces required, and the estimated schedule of building usage; (c) design conditions and criteria that pertain to codes, weather conditions, and building or design requirements; (d) a building design that uses natural conditions (i.e., light, heat, cooling); (e) the inclusion of passive and/or active systems that rely on alternative energy sources; and (f) supplemental systems (conventional electrical and mechanical) for reduced loads.

Equipping. A significant portion of the total cost of a school plant goes into furniture and equipment. As indicated in the preceding Unit (J), their selection and purchase offer opportunities for significant economies. The use of elements based on a common dimensioning system can help ensure that components will go together without on-the-job fitting, that elements can be replaced, and that furniture and equipment can be purchased in large quantities. The opportunity also exists for cooperative buying. Through purchasing consortia, a number of districts or an entire state can buy in quantity at lower prices, once common performance requirements are established.

Mechanical, electrical and plumbing systems. Mechanical, electrical and plumbing components offer opportunities for economy if they are simple to control, easy to maintain, and are selected on the basis of real need. Too often mechanical systems are overdesigned and equipped with costly, elaborate controls that require special personnel and frequent maintenance. As mechanical, electrical and plumbing systems require a larger and larger porton of the school building dollar, it is of great importance that these systems be consistent with needs. It is also important that they do not waste costly and scarce energy.

When possible, the mechanical, electrical and plumbing systems in new buildings should be standardized to systems in old buildings.

Evaluating Costs

Two widely used methods for evaluating costs are life-cycle costing and cost/benefit analysis. Both of these techniques provide information that can improve decision making by supplying objective, reliable criteria with which one site, building design, mechanical system, or piece of furniture can be appraised in relation to others. Life-cycle costing and cost/benefit analysis are important because they allow an informed selection among alternatives based on total rather than initial costs and an examination of cost in terms of value received.

Life-cycle costing. It makes little sense to purchase one product based on a lower first cost if all of the costs involved in ownership of that product are higher than all the costs of ownership of an alternative product. Initial costs are therefore relatively insignificant. Attention should be given to total costs, which include the initial costs of a structure (or any of its components) as well as interest and the costs of operation and maintenance. The objective is to determine the best method of satisfying a particular requirement at the least total cost. The cost of operating an educational facility includes the expenses incurred in servicing the building, such as heating, lighting, insurance, and labor. Maintenance costs ae those resulting from repairs and renewal. In order to accurately figure the life-cycle cost of a facility, it is necessary not only to add up all expenses anticipated during the life of the building, but also to calculate the net present worth or the equivalent annual value of those expenses. Only by bringing all expenses to a common time and value can legitimate comparisons be made.

Life-cycle costing is uncomplicated in principle. In practice it can be complex because of the numerous factors that must be considered and because the cost of some of these factors can only be estimated. Therefore, it is recommended that the technique be employed by individuals who thoroughly understand the full implications of cost and building design and who are able to make consistent, valid comparisons. Either previous successful experience with life-cycle costing or a careful examination of literature that completely describes the technique is required.

The merits of life-cycle costing are not only that it improves economy by developing an awareness of total costs and a comparison of alternative systems, but that it also encourages an examination and understanding of the interrelationships between various aspects of building design and their costs.

Cost/benefit analysis. Cost/benefit analysis enables planners to view various building designs or commodities in terms of benefits provided related to their costs. Its purpose is to identify the alternative that possesses the best set of design features for the expenses involved. Regardless of whether performance specifications or budgetary considerations are of foremost importance, cost/benefit analysis can be helpful.

Cost/benefit analysis requires that benefits be expressed in monetary terms. However, it is often difficult to reduce benefits to a dollar figure, particularly when they are intangible. For example, how can beauty or comfort be measured in dollars? Although these qualities are quite real and important, they are valued differently by different persons. One way of evading this dilemma is to cancel out such benefits when they are common to all the alternatives considered.

Because both costs and benefits are experienced over a period of years, it is essential that they be viewed in terms of life-cycle costs, not just acquisition costs.

Specific Planning Considerations

The owner, planner, and architect have several means at their disposal to control costs. Described below is a sample of those means. In the total activity of planning, designing, and constructing a building, many others are available.

1. Plan early for a total building design that is energy conscious. While initially more expensive, the life-cycle cost of alternative systems can be of significant advantage.

2. At the outset, recognize that the building must be barrier-free. Provisions made at initial construction will be less costly than later renovations.

3. Multistory planning (within limits) can produce savings unless land is relatively inexpensive and building codes give significant cost advantage to one-story construction.

4. Both the campus and the compact plans for arranging facilities should be analyzed for potential savings in construction. Where land costs are reasonable, codes tend to favor building dispersal. Also, educational programs may be strengthened by decentralized facilities. Otherwise, compact plans may tend to be more economical.

5. Construction savings can be realized by keeping exterior perimeter walls (which are an expensive building element) to a minimum. It only follows that if the least exterior wall area is used to enclose the largest possible floor area, construction dollars can be saved. If, however, low perimeter-to-floor area ratios require air conditioning or climatic controls that otherwise would not be included, potential savings might be lost.

6. Modular planning—the use of repetitive units of space based on a common set of dimensions—can provide for potential savings. Such planning permits repetitive use of structural elements, building components and materials, and furniture and casework. It can also reduce opportunities for error in estimating by the contractor. By making initial job layout, inspection of construction, and checking of shop drawings simpler and less liable to error, modular planning can introduce economies during construction. Modular units should be used cautiously so that the environment does not suffer aesthetically.

7. The planning goals should be to provide an efficient arrangement of spaces that keeps the ratio of gross to net square footage as low as possible. Unnecessary corridors, circulation space, lobby areas, duct space, and other nonproductive areas might be reduced without impairing the educational efficiency of the structure.

8. Economies can be realized by avoiding walls that have low insulative values or that impose special problems in providing and controlling natural light, heating, ventilation and air-conditioning. Similarly, careful selection of exterior wall materials can dramatically reduce costs. Partitioning systems for subdividing interior space should be explored. Of course, unnecessary partitions should be avoided.

9. Specifying building and material components that are repetitive in dimension can reduce on-the-job cutting and fitting and provide a significant avenue for construction economies.

10. Selection of materials, finishes, and equipment with proven characteristics of low long-term maintenance costs will provide an economical building if the usable life of the building is considered.

11. Bidding advantages can be gained by selecting—if there is not any major price differential—a structural system that will permit quick closing in of the job so that work can continue out of the weather.

12. Insulation must be carefully designed and specified to avoid underinsulating and to avoid an imbalance of insulation between exterior walls, basement, and roof.

13. As a further consideration in long-term economy, materials should be checked in terms of effect on insurance rates. For instance, while building codes may permit the use of laminated wood beams, insurance considerations may render them more economical in one area than in another.

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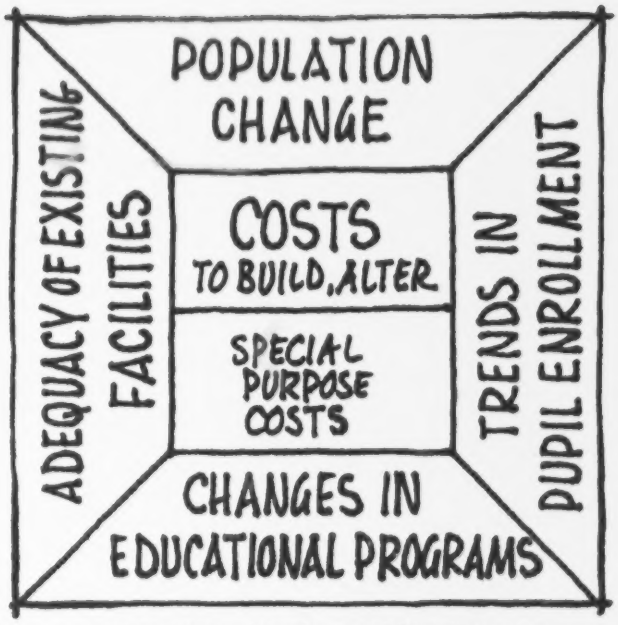
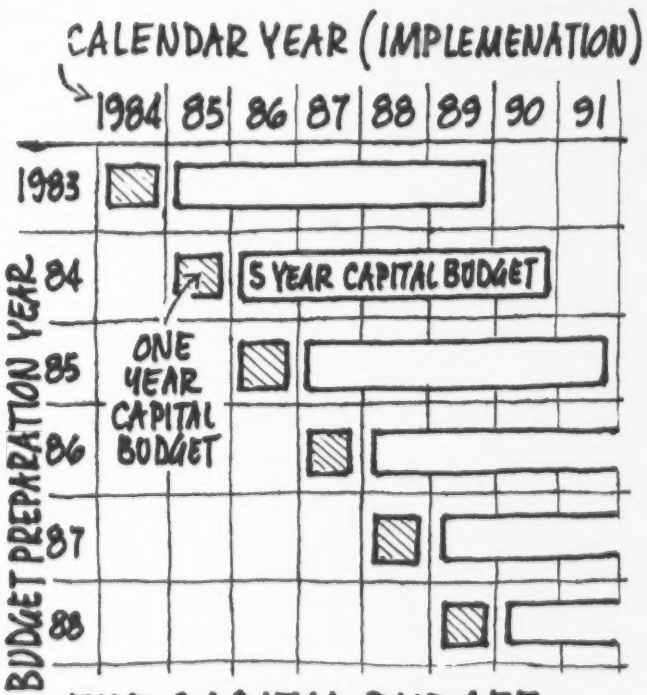
FINANCING THE CAPITAL PROGRAM

Ball State University; Perkins & Will Architects, and Walter Scholer. Photo by Hedrich Blessing.



CAPITAL IMPROVEMENT PROGRAM BUDGET



THE CAPITAL BUDGET: LONG RANGE VIEW

Financing the Capital Program

The capital budget is a statement wherein immediate and long-range capital requirements for educational facilities are delineated in an orderly manner. Preparation of a capital improvement program budget requires critical assessment of: (1) population change within and among various areas of the school district; (2) trends in pupil enrollment within school building attendance boundaries; (3) changes in educational programs, including corresponding changes in school organization and instructional techniques; (4) adequacy of existing educational facilities to house the defined educational program; (5) costs required to renovate, alter, construct, or close educational facilities; and (6) special purposes such as renovation for energy efficiency, providing for handicapped persons, and treatment of asbestos. Continual study is the keystone of successful budgeting for both annual and long-range capital improvement programs.

Organizing the Capital Budget

Organization of the budget document varies among local education agencies. In some localities the format is prescribed by law. In other jurisdictions the budget format is left to the discretion of the local school officials. Documents vary greatly with the size of the school district and with the ingenuity of those responsible for developing the document.

The capital budget should contain two major parts—the immediate or annual capital requests and the long-range estimate of capital improvements. The listing of long-range needs commonly covers a period of five years. Hence, the budget document is a six-year (or annual and fiveyear) capital improvemment program. The fiscal year, running from July 1 of one year through June 30 of the following year, is a popular method of arranging the budget document. Such a timetable closely parallels the school year and is familiar to federal, state and local fiscal authorities.

The first year receives most emphasis because the projects cited for that year will be recommended for immediate funding, while the other data indicate the estimated capital improvements identified for funding during the forthcoming five years. Each year, at budget-making time, these estimated programs are restudied and refined with the first year being recommended for funding. An opportunity is given to revise upward the priority of a project if

the need for it becomes greater. An estimated program for a new sixth year is then added to the long-range budget. Each year this cycle is repeated to ensure continuity in planning and programming.

Three Major Programs

The capital budget document is developed around three major programs: (1) the program that defines educational facility needs, (2) the program of expenditures necessary to meet identified needs, and (3) the program of income to finance the required expenditures. Each area is related to and complementary of the others. Effective capital planning attempts to balance programming, spending, and financing.

Educational facility needs. The first step in developing the capital budget document is to define the capital needs of the school district. This is the foundation of the total budget document. It outlines the facility needs that will be recommended for approval and funding in the next six fiscal years. Priorities are a key consideration and should be decided upon in advance of printing the capital budget document.

From the study of facility needs emerges the listing of recommended capital projects. Unless a project priority arrangement is desired, new schools are generally listed first by year needed. Each request for a new school should be supported with statistics showing enrollment pressures upon existing schools, use of existing schools, and the estimated total cost of the new facility. Regardless of the size of a school system, it is generally considered good practice to include in the document all the details necessary to support each capital project for which funds are being requested.

After requests for new schools are set forth in the budget, the requests for additions to existing schools should be listed by year needed. Considerable detail is also needed to justify an addition.

Recommendations for alterations and renovations of existing schools should be listed next by year needed. Usually the capacity of a school is not increased by renovation or alteration projects. Therefore, enrollment studies are not of prime importance unless renovations result in the use of existing classrooms for special subjects or unless confirmation of sustained enrollments is required. Instead, the relationship of the existing facility to the instructional program must be discussed in

justifying the project. Qualitative rather than quantitative needs, therefore, are primarily at issue.

Maintenance needs are usually included in the five-year capital budget if their scope and cost are too great to handle in an annual budget. It is customary to require that the costs for a maintenance project exceed a minimum amount before its inclusion. Such amounts vary according to the total planned expenditures in a given year.

A phenomenon brought on by declining enrollments in many states and districts is the cost of closing a school building, changing its function, or being divested of it. Closing can result in costs for mothballing and continued security supervision. A change in function to an administrative center, warehouse, community facility, or other uses can necessitate some capital expenditures. The closing of a building, however, can mean that it is removed from a long-range capital plan, thus reducing dollar needs. Careful planning is needed. Other options include the leasing or selling of a building, which can provide revenue for capital costs.

A final category of recommendations should treat capital projects related to, or supportive of, the educational program. These may include items such as advance land acquisition, central and administrative facilities (including maintenance and warehouse buildings), capital programs for the total school system such as improved play areas, and adjustment of all buildings to meet a new code regulation.

Expenditures. The second section of the capital budget document defines costs of recommended capital projects. The format of this section of the budget parallels the preceding section. It estimates costs for each recommended new facility, addition, alteration, or renovation; the cost of furnishings and equipment required for each capital project; and the cost of providing those items by the year needed, related to or supportive of the instructional program. It is recommended that only the total cost figure be listed for each capital project. The inclusion of detailed costs may prove economically imprudent—it may result in high bids and prices. They should have been shared internally, of course, in order to gain support.

The cost estimates should include increases attributable to inflation. Depending on the economic stability of the times, allowing for inflation can be a simple task or a very difficult

one. Consultation with architects as well as with leading trade journals is helpful.

Financing. The third major part of the capital budget document shows how recommended capital improvements will be financed. Several alternatives for capital improvement financing, discussed later in this seciton, are open to boards of education. The recommended methods should be indicated and explained in considerable detail. The anticipated impact of the preferred alternative on the tax rate should be noted. For example, if long-term bonds are to be sold to finance the capital budget, then the bond amortization schedule should be included. This practice will minimize the apprehensions of the readers, especially the appropriating agency.

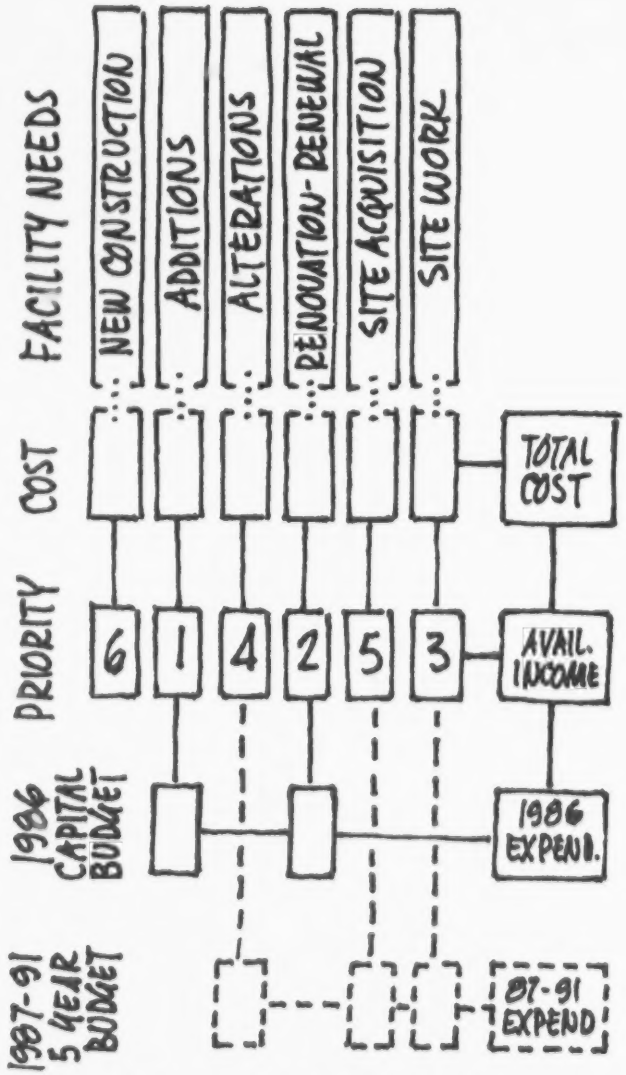
The Budget Calendar

Successful development of the capital budget document may rely on the involvement of both professional educators and the lay public. This range of participation is especially important in school systems that require a referendum to approve the capital budget.

The mechanics of budget planning from isolation of need through implementation of approved projects consist of three major phases: (1) the preparation phase, (2) the review and adoption phase, and (3) the implementation phase.

Preparation. Preparing a capital budget requires a survey of existing educational facilities and includes an examination of current and predicted enrollment figures. A list of capital improvements can be developed from the results of this survey. The expenditure required for meeting total needs may be prohibitive. Therefore, priorities must be delineated and the annual and five-year capital improvement program planned. Each project to be included in the budget document is analyzed in detail, its cost is estimated, and a feasible plan for financing is developed. The detail, in this case, generally does not mean the development of educational and architectural specifications for capital projects. To do them often is nothing more than an exercise since projects can be dropped because of changes in priority or lack of funding.

It does not mean developing detailed cost estimates on gross planning figures. For example, a new building can be costed out only by determining the capacity, multiplying it by a square foot allowance per student, and then computing estimated costs. Assistance is available from architects, engineers, and professional estimators.



CAPITAL BUDGET PREPARATION

Review and adoption. After the budget document is assembled, it is submitted to the appropriate individuals and agencies for review. Usually the superintendent of schools and key administrative personnel make the first review. In fact, this review precedes the final compilation of the budget document. The completed document is usually referred to as the superintendent's budget of recommended capital improvements.

The first review of the superintendent's budget is done by the board of education. In fiscally independent school systems, the board generally has final authority over the completed budget document. If the school system is fiscally dependent, then a review body above the board of education examines and finally approves the recommended capital improvement program.

When the budget is adopted, the school officials must plan for implementation of the budget, usually beginning on the first day of the upcoming fiscal year.

Implementation. A smooth transition from the adoption phase to the implementation phase is a matter of efficient management. Phasing is the most critical task in effectively implementing approved capital projects. Proper phasing ensures: (1) facilities that are ready when needed, (2) avoidance of unnecessary disruption of the instructional program, and (3) bids within the budgeted funds.

Phasing should be considered during initial budget preparation. In large projects, it is usually possible to budget funds to defray planning expenses for the upcoming fiscal year, thereby deferring construction expenses until the following fiscal year. Other advantages of phasing are that it allows time to thoroughly study costs, it helps to ensure adequate funds for construction, it eliminates having capital on hand that is not being spent but upon which heavy interest is being paid, it allows the furnishings and equipment costs to be figured in an upcoming budget, and it provides time for the writing of an educational specifications document.

The Individual Capital Project Budget

Successful educational facility construction programs are predicated upon accurate and complete budgeting of each individual capital project. Each item of expense that will accrue to the school district during the total construction program should be listed.

Following are major headings found in many project budgets. The nature of the project and the financial rules and laws applicable to the school district determine which of these will be included in the budget for a single capital improvement project.

The educational facilities survey. Funds for financing the educational facilities survey pay for outside educational consultants, drawings of existing facilities, engineering feasibility studies, maps, printing services, travel to other school districts, and other costs incurred in connection with the survey.

Acquisition of land. This category includes the budgeting of surveys of land parcels, appraisal costs, engineering studies, topographic studies and test borings, legal fees, purchase price of the parcel, court costs if condemnation is employed, and cost of removing existing structures from the site.

Fees and planning costs. Included here are fees to the architect. Other planning costs cover educational consultant fees, including the development of educational specifications, travel costs to study other schools, and cost of involving lay committees in the planning process. It is very important to reach a clear understanding on what services are covered by the architect's fee. The board of education may desire architectural services beyond what the normal fee will cover. Engineering services, cost estimating, and interior design, for example, may be beyond the scope of the achitect's contract.

The construction contract. In some localities the building contract is termed the general contract and covers the complete construction project. In others there may be separate contracts for general construction, structural steel, plumbing and drainage, and heating and ventilation. This is an extremely important part of the project budget and must be the subject of careful study.

Site preparation and development. This portion of the project budget includes all costs incurred in preparing the site for educational use. These costs include items such as utility service hookups (water, power, sewage, and gas), provision for site drainage, planting and landscaping, creation of play areas, blacktopping, fencing, installation of play equipment, erection of the flagpole, illumination of both the site and the exterior fo the building, and miscellaneous improvements.

Furnishings and equipment. Some items of furniture and equipment are included in the general contract. However, all movable items are

generally purchased outside the contract and must therefore be separately budgeted. This planning requires a comprehensive review of all needs. If consultants are employed to plan the furniture and equipment needs for the project, the cost of these services may be included in this category of the project budget.

Inspection (clerk-of-the-works). A resident inspector may be hired by the board of education to supervise the construction. The inspector's salary and expenses are included in the project budget. Often a trailer is used as an on-site office and requires heat, light, and telephone services. Sometimes the inspection costs are included in the category of administrative costs. Sometimes this service is provided by the architect and made part of a contract.

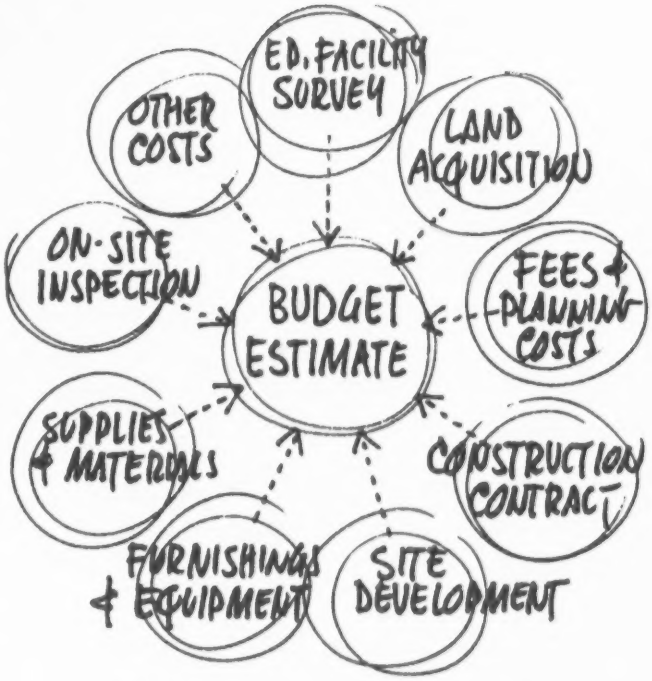
Administrative and legal costs. These costs include advertising, postage and shipping charges, publicity, accounting, office equipment, and salaries for certain personnel in large school systems. Also considered here are insurance costs, fees and costs for preparation of legal documents, handling of certain performance bonds, maintenance bonds, guarantees, examination of regular and special contracts, cost of bond sales, and fees for administering property and land transactions.

Insurance costs. There are generally three types of insurance carried by the board of education during the construction program: worker's compensation, fire and public liability insurance.

Contingencies and other costs. This final category of the project budget contains funds held in reserve for emergency and unforeseen happenings that may arise during the building program. For example, during excavation rock that was not indicated by the test borings may be encountered. Funds needed to cope with such an unforeseen problem as well as with change orders are obtained from the contingency allowance.

A contingency fee should be set for each project. Generally, a range of up to five percent of the estimated construction costs is considered a sufficient amount. Renovation projects may require an additional one or two percent unless accurate as-built drawings are available.

Expenses caused by the need for temporary heat during construction are an example of an item that could be carried under "other costs of construction." Certain change orders and dedication costs may be financed from this account also.



THE CAPITAL BUDGET FOR AN INDIVIDUAL PROJECT

Financing Capital Improvements

Financing of capital programs has in the past been left almost exclusively to local initiative and resources; most is accomplished by bonding. As local debt services increase and prices soar from inflationary pressures, school districts may find it more difficult to finance capital programs. A choice from several methods of financing must be made.

The Options

The options include: (1) pay-as-you-go, (2) state or provincial aid, (3) federal aid, (4) shared facilities, (5) non-tax revenue, (6) leasing, (7) bond issues, and (8) state bonding authorities.

1. *Pay-as-you-go.* Some school districts pay cash for school construction. This method of financing may be achieved through one-time levies, after voter approval by referendum, or by accumulation of money in a reserve fund. Such plans are not legal in all states. Additionally, while interest costs are avoided, construction costs may escalate at such a rapid pace that no actual savings are realized by waiting until cash is in hand.

2. *State or provincial aid.* State or provincial aid may assume the form of either a grant or a loan. In the past grant programs were used as incentives to encourage school district reorganization or consolidation. Currently, state grants help provide property tax relief and equalization of school facilities resources at the local level. A trend toward more grants is now evident. Maryland's full state funding program is an example, as is shared funding in some provinces. The recent wave of judicial attacks upon state school finance programs has caused policymakers to recognize that serious interdistrict disparities in local tax capacity exist and that these inequities are severe in the area of capital ability. The New Jersey Supreme Court, for example, said in *Robinson* vs. *Cahill*, (1973) that equal opportunity to education includes access to facilities that are equal.

There has been a recent wave of taxpayer attacks, such as those in California and Massachusetts. The attacks have resulted in prohibitions and limitations on state aid for capital improvements. The consequences of these actions have been reductions in state funding that are largely non-tax in nature.

The intent of state loan programs is to provide needed revenue to those school districts unable to sell bonds on the open market. Some school districts have a poor bonding rating, are too poor to incur debt, or are unable to gain approval of a referendum. For these reasons state loan programs have been beneficial—but the problem of repayment still persists for the poor district.

3. *Federal aid.* Although federal aid for school facilities is meager, there is some assistance for federally affected areas under Public Laws 815 and 874. Direct aid might be possible for vocational education facilities. Some districts may be eligible for funds under the Public Works Employment Act or the National Energy Act. As with program support, federal capital funding is categorical in nature.

4. *Shared facilities.* Libraries, physical education facilities, health clinics, auditoriums, and even dining facilities can be shared to reduce costs. This is done by either leasing to another agency, building these spaces in conjunction with another agency, or sharing first costs based on the pro rata usage of each agency.

5. *Non-tax revenue.* Methods of generating finances through this means include selling or exchanging property owned by a school district for other property where a gain is realized, selling or leasing ground or air rights over school property, and construction of educational facilities that have rentable space within the building. These methods may or may not be legal in every state.

6. *Leasing.* There are two types of leases, short-term and long-term. Short-term leasing may eliminate overcrowded facilities temporarily. Relocatable buildings are often used. Long-term leasing is tantamount to the district buying the facility by paying a rental fee until the cost of the building has been paid. Oftentimes, there is a corresponding loss of state capital aid because a district entering into a lease technically incurs no debt.

7. *Bond issues.* Most school districts rely on the sale of local bonds to raise the funds needed to support capital construction. Very often bond repayment schedules are twenty to thirty years in duration.

8. *Bonding authority.* Some states impose unusually low debt limits on school districts and the conventional method of local district bonding cannot provide enough monies. Either a state building authority or a nonprofit local authority may float revenue bonds, build the school, lease the school (on a year-to-year basis), and turn the title of the building over to the school district once the bonds are retired. Long-term lease purchase plans also may be accomplished with

private, for-profit companies. This method of financing, not legal in all states, has been used successfully in Pennsylvania.

Incurring and Managing Bonded Debt

The greater part of school construction is financed through borrowing accomplished by issuance of school bonds. Attention, therefore, should be given to factors that can help determine the availability of funds and the cost of using this method of financing.

A bond may be defined as a formal written obligation specifying the conditions under which a loan is to be repaid. The conditions include the fixed sum of money (the principal) that will be repaid, the dates of repayment, the rates of interest, and the procedures by which payments of principal and interest will be made. Bonds are usually issued in denominations of $5,000. Interest payments are usually made semiannually.

Two types of bond issues are used—term issues and serial issues. In term issues all bonds reach maturity at the same specified time. Some states make provisions for school districts to set up a *sinking fund* whereby taxes collected for bond retirement purposes are invested and draw interest until the bond issue matures. The interest earned is used to offset the cost of borrowing.

The more prevalent type of issue is the serial bond, which means that different amounts of bonds reach maturity each year during the life of the issue. The amount of interest and principal due each year can be structured to allow for stable, long-term fiscal planning.

Bonds of all state and local governmental units, including school districts, are classified as municipal bonds. The interest yield to the investors is tax-free, which generally enables governmental units to secure more favorable interest rates than private borrowers can obtain.

School building bonds that pledge the full faith and credit of the school district are termed general obligation bonds. Bonds sold by a bonding authority that are to be repaid from earnings of a public enterprise, such as a toll road or college dormitory, are classified a revenue bonds.

General obligation bonds ordinarily command lower interest rates than revenue bonds because of the greater degree of security for the investors. Revenue bonds can be used for school construction purposes by the authority created with the powers to issue such bonds. This method can eliminate statutory debt limitations or the need for voter approval. The funds for principal and interest payments accrue to the authority in the form of rents paid by the user of the facilities.

Voter approval. Voter approval is required in the majority of states for the issuance of public school general obligation bonds. Often it is difficult to secure voter approval, particularly if the school district is not engaged in a continuous program for the development of public understanding and support. Moody's Investor Service suggests several obstacles to public support of bond issues: unwise scheduling of the election, failure to present as lucidly as possible the necessity for the issue, and failure to use available media.

Interest costs. Interest costs on municipal bonds are determined largely by the character and financial capacity of the issuer, the length of term of the issue, and the availability of investment capital at the time of the issue. On a twenty-year issue of a million dollars, which is to be repaid in equal annual installments of principal, a variation of one-eighth of one percent in the interest rate will amount to $13,125 in interest charges. It therefore becomes very important to secure the best possible interest rate.

Financial capacity and character of the issuer. Potential investors are concerned with the community's ability and willingness to retire its debt. Also the appraisal of financial capacity and character has an important bearing on the interest rate that will be obtained.

An important factor is the amount of existing debt and its ratio to taxable wealth. If total debt approaches ten percent of the true value of property, interest rates are likely to be relatively high—if investors can be found. Overlapping debt of other governmental agencies is also considered, as are the probable future capital needs of both school and civil governmental agencies of the community.

Ability to retire debt is dependent upon sources of revenue available to the school district. State grants for debt service or state guarantees of debt reduce the risk to investors and should favorably influence interest rates. If the local property tax provides debt service funds, the size of the tax base relative to the number of pupils and the total population is quite important. Also, the composition of taxable wealth with respect to diversification among personal property, and industrial, residential, commercial, and agricultural elements is another influence on interest rates.

The trend of tax rates indicates whether the community is fiscally conservative, willing to support schools and other governmental functions, or is perhaps overextending itself. Rates are analyzed with respect to assessment procedures to determine effective tax rates or the ratio of the tax burden to true value of property.

Interest rates are adversely affected by past defaults of financial obligations, history of school or civil referenda defeats, litigation on bond issues and embezzlements. Tax collections considerably less than amounts levied indicate that citizens and governmental officials are indifferent toward their responsibilities. This negatively influences interest rates.

Length of term. Not only are interest rates likely to be higher as the length of term of the bond issue increases, but interest costs are considerably greater as the maturity schedule is lengthened. Bond issues should be kept as short as is feasible. If it is necessary to issue bonds for long terms, provisions should be made for earlier retirement of debt if and when economic conditions permit. The provision for calling bonds prior to their original due date is of an advantage only to the seller, however, and slightly higher interest rates are bid on bonds with call features.

Timing of the issue. The bond market is highly competitive, and supply and demand factors prevailing at the time of the sale of bonds affect interest rates. Short supply of investment capital coupled with a large volume of bonds mean that interest rates will rise.

Competition exists among governmental issues of investment capital, and monetary conditions in the private sector of the economy are important determinants of the general level of interest rates. The school district has little or no control over general economic conditions, but it might be able to arrange its bond sales for a day or week when no unusually large issues are competing. The *Bond Buyer*, the *Wall Street Journal*, and financial pages of large metropolitan newspapers are sources of information with respect to the status of the bond market. Bond dealers and investment bankers also can furnish valuable guidance on the most suitable time to market bonds.

Necessity for adequate legal assistance. The necessity for competent legal services when planning and administering a bonding program cannot be overemphasized. Competent counsel is needed to meet the legal requirements existing in a particular state, and the attorneys may assume responsibility for directing school officials through these steps. If a local attorney is used, he or she should receive counsel from nationally recognized bond attorneys who must approve the legality of an issue if it is to be favorably received by major bond buyers. It may be advantageous to a school district to work directly with a nationally known bond counsel.

Bond rating. Ratings serve investors as general measures of the quality of an issue. Three major rating firms are nationally recognized: Moody's Investors Service, Standard and Poor's Corp., and Fitch Investors Service. Nominal fees are charged by bond rating firms, but the value accruing to the school district by having their bonds rated may be well worth the expense.

Ratings are contingent upon full disclosure of required information with respect to economic conditions in the community, its credit history, debt pattern, and other financial factors.

As a general rule, rated bonds will secure a more favorable interest rate than nonrated bonds. Many school bonds are not rated either because the outstanding debt is too small or because sufficient information is not made available to the rating agencies.

Moody's ratings scale evaluates bonds from high quality to high risk; most school bonds are rated from Aaa down to Ba with the majority rated Aa, A, or Baa. Standard and Poor's uses a similar scale with AAA, AA, and A indicating the highest quality and C, DDD, and DD representing poor quality bonds.

Full cooperation should be given to the rating firms to secure the best possible rating and thereby lowest interest cost.

Advertising the sale. Bids on school bonds should be encouraged by providing information to potential investors. Advertisements in publications such as the *Bond Buyer,* the *Wall Street Journal,* and regional and local financial chronicles provide opportunities for broader participation in the bidding. Pertinent data concerning the issue and the community should be forwarded to underwriters and potential investors.

A prospectus can include most of the detailed information about the school district and the community needed by investors to facilitate intelligent preparation of bids. The prospectus should describe the community's social and economic characteristics, nature of industry present, population data, assessed valuation, total tax levy, tax rates, tax collection record, total debt analysis, and the amount of state aid. If there are

particularly large taxpayers such as a public utility or an industrial plant, the assessed valuation and a description of these properties as tax entities should be stated. Some estimate of future need for school facilities should be provided. For example, the fact that a district requires no additional classrooms in the near future could be very important.

The debt of other public bodies (fire, sewage, water) that overlap the school district should be presented in the prospectus. Complete details on the bonds presently being offered, the maturity schedule, the place of payment, and the provisions for the redemption of these bonds before maturity should be described in the prospectus.

A roster of past investors and other interested parties should be maintained on a mailing list and kept current. Copies of the prospectus should be sent to these possible investors.

Factors affecting voter approval. Research findings on bond referenda may be helpful to school districts anticipating elections. Past research tends to show:

1. In general, bond elections are more likely to be successful the earlier in the calendar year the election is held.
2. The poorest times of the month for an election tend to be just before the middle of the month and during the last few days.
3. Thursday or Friday appear to be better days of the week. Vacation periods and holidays tend to be negative times for holding bond issues since supporters of the issue may be away.
4. The degree of success does not seem to be influenced by what percentage of the registered voters participate in the election.
5. The practice of telephoning all voters either on election day or the day before tends not to be helpful.
6. Organized opposition is harmful and time spent overcoming this opposition is worthwhile.

Research also indicates that approximately 75 percent of voters tend to make up their minds about bond issues the very first time they hear about the issue. For this reason the first announcement should be well done.

According to Moody's there are a number of positive things that can be done prior to the election. Certainly, the board of education should come out unanimously in favor of the need for the bond issue.

It also has proven beneficial to study the previous bond election from the beginning of that campaign to the outcome. Enlisting the active assistance of civic groups such as the League of Women Voters tends to help.

Where bond elections have been successful, school boards have been honest and have kept the public completely informed. The facts have been reported clearly, completely, and to all available media. Showing the voters that the district has a long-range capital program and what the needs will cost tends to make the public aware that proposed improvements have been thought out carefully and in a businesslike manner.

Finally, handouts telling the bond issue story are useful along with the usual poster, billboard or button ideas and approaches.

Public relations does not end with the approval of a bond issue but continues until the bonds are redeemed.

Things that have been done to ensure a satisfied bond holder include keeping the investor informed about the school district's performance, and having funds deposited and available at the paying agency on time for payment of earned interest.

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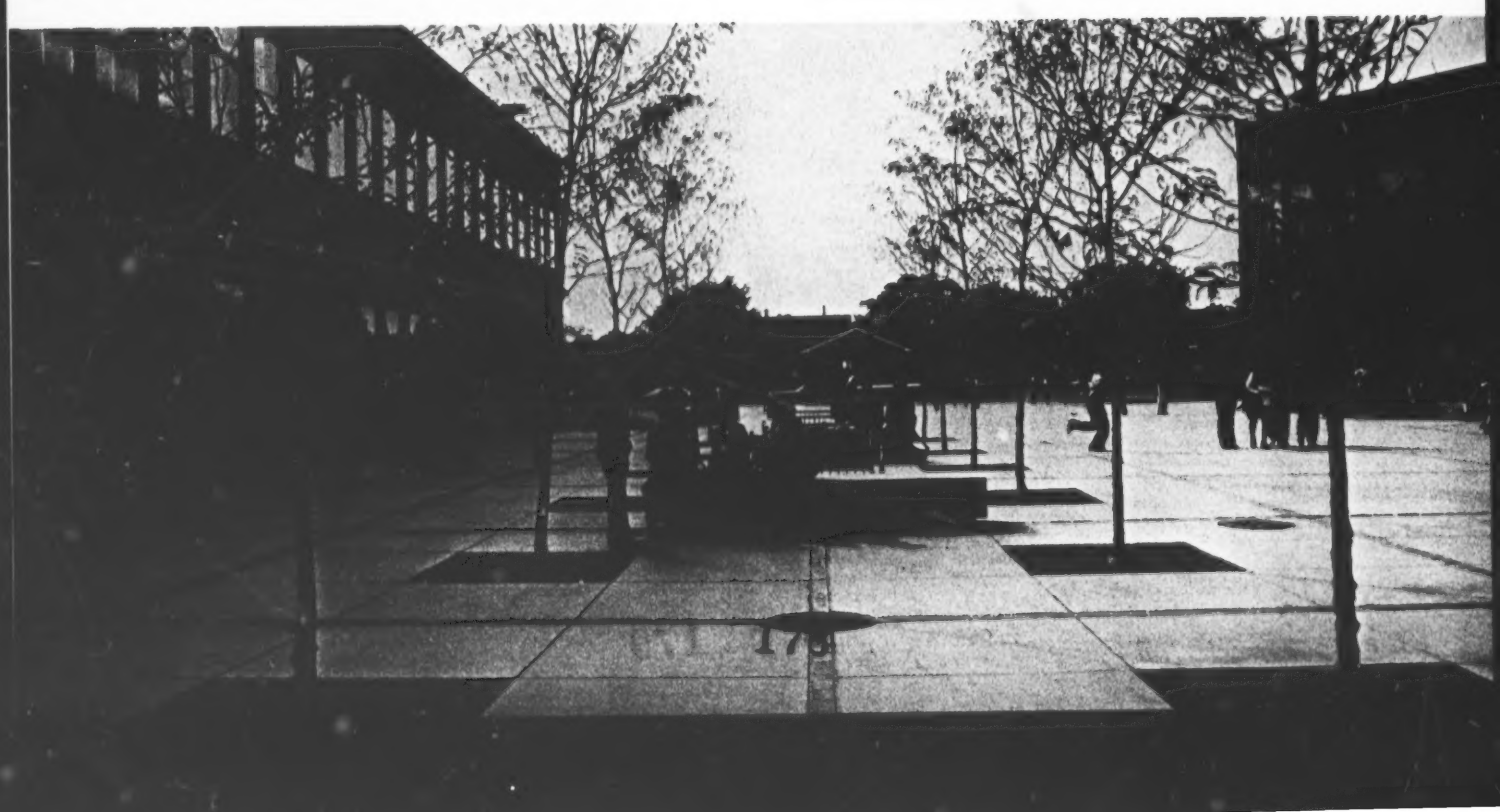
THE CONSTRUCTION PROGRAM

Corliss H.S.; Skidmore, Owings & Merrill Architects. Photo by Orlando Cabanan.



THESE ACTIVITIES are regulated by law and/or require the use of legal counsel:

— Determining school construction needs
— Estimating the taxing power of the school district
— Arranging for funding of the school construction debt.
— Approving, issuing and selling bonds.
— Validating bond recitals or transcripts of bond proceedings.
— Building budgetary procedures.
— Financing capital outlay by other methods.
— Selecting and acquiring school sites.
— Selecting and contracting for professional services.
— Preparing programs of educational and community requirements.
— Processing building plans.
— Preparing and accepting bids for construction.
— Validating school building contracts.
— Dedicating and accepting the public school building.

The Construction Program

This Unit contains an overview of administrative and legal considerations facing the school district involved in the construction of an educational facility. The following topics are discussed: the legality of construction, building codes and regulations, advertising and bidding the project, award and execution of construction contracts, contractors and subcontractors, construction administration, payment of contractors, construction management and design/build.

School Construction and the Law

Handling legal issues is an inevitable part of any school building project. Site acquisition requires title clearance and transfer, and in certain cases, may involve condemnation proceedings. Most building programs require authorizations for bonding, public legal notices, review of bids, award of contracts, and approval by state and local authorities before certain phases of the building project can proceed. These activities are controlled by law and sometimes require approval of the electorate.

Boards of education must exercise their authority with due regard for provisions of state legislatures and requirements of state departments of education. When unique or complex problems occur, the legal divisions of state education and/or justice departments may be consulted for guidance. Most states can also be expected to give day-to-day advice on interpretations of statutes and regulations. It is important, however, that boards of education secure additional legal advice by employing a competent attorney. Legal counsel is usually obtained by (1) hiring a lawyer as a member of the local education agency administrative staff — thereby insuring full-time availability of legal advice or (2) retaining legal services as circumstance necessitates. These two forms of service may be used in combination.

Authority of States. School boards derive their authority from statutes of the state and can exercise no powers except those expressly granted or those which result from necessary implications of the grant. Districts may be organized or reorganized by state legislatures. Cities and towns may not expend funds for school construction unless expressly authorized by statute. It is therefore important for school boards to be aware of the legal implications of their acts and responsibilities.

Codes And Regulations

Building codes and regulations should protect the public against inadequate design or construction. The extent to which codes and regulations govern

the design and construction details of an educational facility varies among localities and depends as much upon degree of enforcement as upon severity of the regulations themselves. National codes govern most aspects of building construction and design. In addition there are state laws, state department of education regulations, and codes and ordinances adopted by local units of government. Many agencies adopt national regulations by reference.

The nature of law is such that no government unit can adopt standards that are less restrictive than those of a higher authority. Consequently, the locality that has a city code, in addition to state and national codes, imposes additional restrictions upon the school district, architect and contractor. As a result, a facility built in a given area may be required to be "more safe" than a similar structure located elsewhere.

The impact of the relatively few locations where comprehensive codes are enforced is felt nationally because of the importance of these markets to contractors and manufacturers who adopt procedures and produce equipment for general use. This practice tends to provide a measure of enforcement of standards in all construction.

National codes are not controlling in themselves but require adoption by a state or local authority. Their value lies in the uniformity made possible by widespread adoption.

The form, content and enforcement of building codes and regulations vary. Requirements generally deal with the physical structure of the building, and they may apply to repairs and alterations of existing buildings. Codes are applied through ordinances and statutes providing for administration, fees, penalties, etc. Inspection procedures both during and after construction vary according to adequacy of staffing and financial support. Severe violations are usually handled by administrative boards or the courts.

Building codes and regulations can have a major impact on the cost of a project and freedom of design. This effect is most severe when codes treat material rather than performance specifications. Therefore, school districts should contribute to the updating of codes and regulations so that their application supports rather than obstructs the educational process and design innovations.

Advertising And Bidding The Project

Advertising for Bids. With the completion and approval of the final working drawings and specifications (usually termed the bidding documents), a

WHAT DO BUILDING CODES REGULATE?

Structural and foundation loads and stresses
Construction materials
Fireproofing
Building heights
Ventilation and air conditioning
Plumbing fixtures and installation
Heating system construction and equipment
Electrical installation
Elevator and escalator construction and safety devices

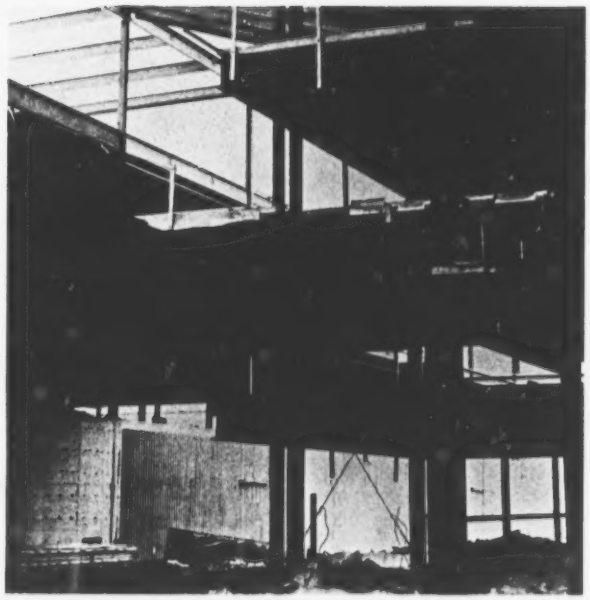
CONSULT THESE federal, state and/or local agencies and codes:

National:

Building Officials Conference of America
Occupational Safety and Health Act
Uniform Building Code
National Electric Code
National Plumbing Code
Uniform Mechanical Code
Federal Energy Administration
Environmental Protection Agency

State and/or Local:

Earthquake Safety
Hurricane and/or Tornado Safety
Fire and Panic Safety
Health and Sanitation
Air Pollution Control
Noise Pollution Control
Water Pollution Control
Aeronautical Safety
Highways and Streets Safety
Accessibility Requirements for Physically Handicapped



Hazelwood East Sr H S., Florissant, Mo.; Wm. B. Ittner, Architect

Champlain Heights Elementary, Vancouver, B.C.
photo courtesy Vancouver School Board

school project is ready to be released to contractors to obtain tenders or bids. Most school districts follow the practice of advertising and obtaining competitive bids as a matter of law. If poorly handled, advertising and competitive bids can result in higher building costs than such a competitive system should produce. Carefully prepared bidding documents and detailed procedures are necessary to obtain all the potential benefits of this system.

The requirements for advertising the project are usually met by inserting an announcement in a local daily or weekly newspaper or in the legal news publication of the locality. In addition, the architect should prepare a list of firms to be invited to bid. Many localities have a builders' and traders' exchange which maintains a plan room where sets of drawings and specifications are made available to all contractors, subcontractors and suppliers. Inviting firms to bid, whether by telephone or by mailing an "Invitation to Bid" is the surest method of announcing to the construction industry that a school project is out for bids.

Obtaining Bids. The advertisement for bids should state the time and place of receiving the bids; where the bidding documents may be picked up and the deposit required; a brief description of the project; and any conditions which are attached to preparing, submitting and opening the bids. A large school district may wish to develop its own advertisement; however, a form is available from the American Institute of Architects.

The architect is familiar with the project and the estimating practices of local contractors and suppliers and can estimate a reasonable time for bidding.

The selection of the date when the bids are to be received should take into account other projects on which tenders are being requested, both in the immediate locality and in nearby areas. A failure to consider the other projects with which the contractors may be involved may result in high bid figures, and sometimes, to the embarrassment of everyone, no bids at all. If, after a project is out for bids, it is discovered that another project is competing, a change in the due date may be considered. Occasionally, the firms intending to bid on a school project will request an extension of the due date. Such requests should be carefully considered and granted if possible, for they usually result from contractors' inability to obtain quotations or insufficient time to estimate those work divisions to be done by the contractor's own crews. Failure to extend the due date may again result in high figures or a lack of bids.

An evening submission time has become common. The bid registry (or depository) system has been developed to avoid the problems of last minute compilation of bid figures. Under this system, the contractor is given a period of time, usually 24 hours, to evaluate tenders from subcontractors and suppliers. For this system to work, there must be a managing organization available which is trusted by the bidders.

Award And Execution Of Construction Contracts

After bids have been received and examined, contract award can be made by a resolution passed by the board of education. The form of the contract document is generally prescribed by the local or state board of education or by state statute. It is important that the attorney for the board of education examine the contract and approve the procedures under which the award is to be made. It is also imperative that the board understand its responsibilities and rights under the law. Complete implications of the contract must be understood by all parties concerned. Some areas of particular interest are:

Negotiation. Negotiation is the act of establishing the terms of an agreement. The parties discuss the proposed terms of the contract before the final writing is made. This is accomplished by oral discussion or by an exchange of written proposals.

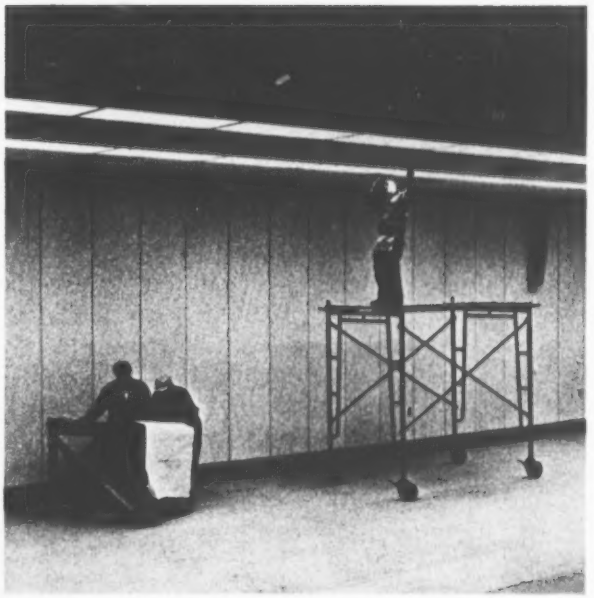
In contracts for school construction, the plans, specifications, and bidding procedures determine the terms of an agreement. The general rule of law is that the contract subject of the bid cannot be changed in substance without rebidding. Negotiations are permissible to clarify or correct the agreement and change orders are acceptable if they do not constitute a new work agreement. New work must be rebid in compliance with the laws.

Change orders. A board of education has the power to issue change orders for any contract that it had the authority to enter, but only where it acts within its authorized limits. Where statutes limit the freedom of public bodies to make new agreements, authorized procedures must be strictly followed. Where statutes are not limiting, the force of law depends on the specific contract. Many contracts contain provisions requiring written change orders. The project architect may act as the authorized agent of the board to clarify or modify plans and specifications within the terms of agreement to construct a school building.

Agreements for entirely new work are not within the terms of the original written agreement to construct

Champlain Heights Elementary, Vancouver, B.C., photo courtesy Vancouver School Board

Champlain Heights Elementary, Vancouver B.C.; photo courtesy Vancouver School Board



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a public school. All new agreements must comply with the statutory procedures of formal notice, bidding, and awarding of contracts by the board. The line is not easily drawn between entirely new work and an acceptable modification, clarification, or addition of an omission within the contract. These distinctions require careful consideration of the nature of the work, the contract, and the statutes in force as well as the acceptable customs and business practices acknowledged by the courts.

Breach of contract. Any legal duty of a contract is discharged or terminated by full and exact performance. Full and exact performance pertains not only to the character, quality, and amount of work, but also to the time within which the work is performed.

When the contractor asks damages for a breach of contract for non-payment, he must prove an action or inaction by the defendant that constitutes a breach. The primary contractual duty to render a promised performance continues to exist even after a breach has been committed by one party. The duty to make compensation after breach is a secondary duty. Payment of money by the school district can be rendered after the exact due date and the payment acts as a discharge of contract whenever paid. However, the obligation for the breach continues to exist. The creditor can assent to receive the payment as satisfaction and dismiss the suit.

When the school district specifies an exact time for completing the construction of a building, it may claim damages resulting from the contractor's failure to perform on time. The courts will demand evidence of damages resulting from the tardy performance. Special damages could include rented classroom space, transportation of furniture to the rented spaces, storage charges for furniture and equipment delivered but not installed on school property, and any other expenses caused by the contractor's failure to perform within a specified time. School districts are obligated under the general rule of law to mitigate any damages.

Substantial Performance. Damages will not be awarded if it is judged that the terms of agreement have been substantially performed. When a building can be put to the use for which it was intended even though comparatively minor items remain unfinished to make the building conform to plans and specifications, substantial performance may be satisfied.

Conditions and Promises. An important distinction exists between a promise and a condition in a contract. A promise is an expressed intention to render a future performance. A condition is a fact or event

and not an expression of intention nor an assurance nor a promise that the conditioned fact or event will occur. A promise creates a legal duty in the promisor and confers a right on the promissee. A condition is a modifying factor and creates no right or duty.

The first step in contract interpretation is to determine if the expression in the contract was a promise creating duty or a condition dependent upon some performance by another or some future event. Breach of contract occurs upon nonfulfillment of a promise and creates a right to damages. Often the contracting parties do not make this logical distinction and the court must interpret the contract in a manner that is most reasonable and just.

Arbitration. Arbitration is the submission of a disputed matter to a private, unofficial person or persons selected in a manner prescribed by law or agreement. The usual method of selecting arbitrators for building contract disputes is to have each side select an arbitrator who in turn select a third arbitrator.

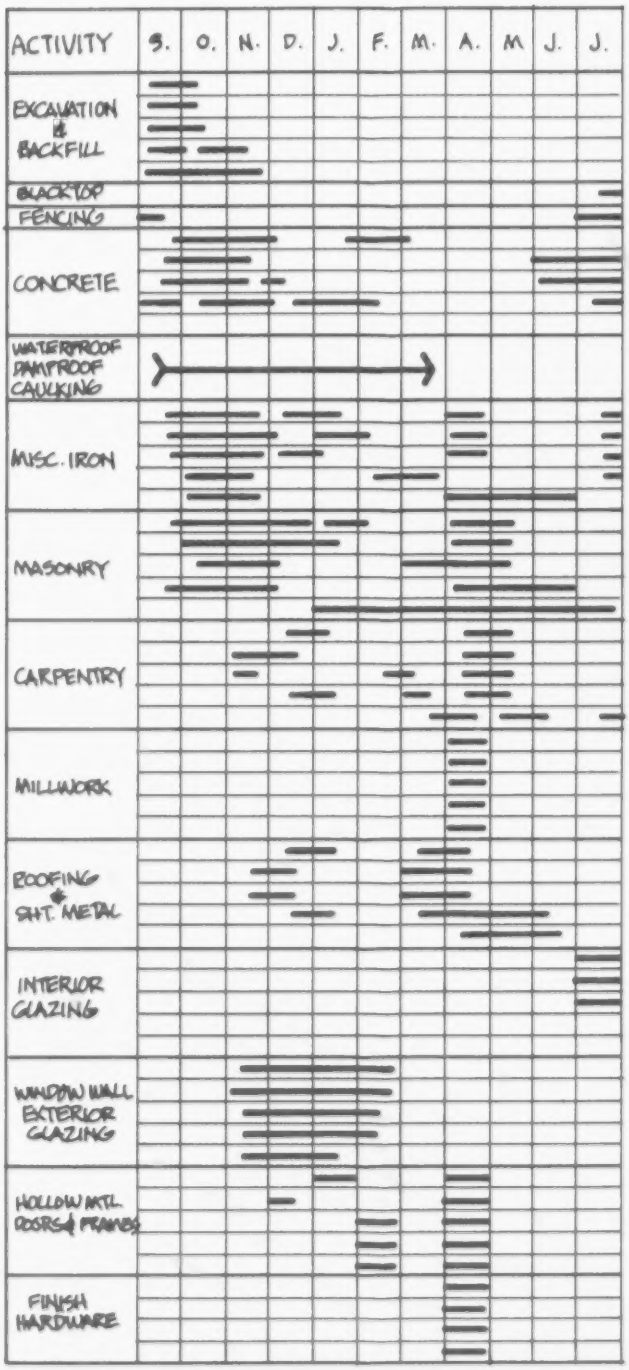
A provision for arbitration is included in most contracts. The provision for arbitration of disputes as a condition precedent to any right of legal action may be modified, rescinded or waived by agreement or by the conduct of the parties. Generally, agreements to settle disputes by arbitration cannot be revoked by the parties after the arbitrators make findings and awards or unless the arbitration can be shown to have been fraudulent or beyond the arbitrator's authority. Arbitration clauses are unenforceable when they attempt to prevent or deprive a court of its power to act in a case.

Contractors And Subcontractors

It is a common practice for contractors, either with the bid or following bid opening, to submit to the architect a list of subcontractors which they propose to employ on the project. The list of approved subcontractors is a binding part of the contractual relationship and, to a significant extent, it sets the level of quality which can be expected on the project.

It is the contractor's responsibility to develope a schedule of progress for the project. The schedule establishes when and for how long the various divisions of work occur. A bar chart is the most common form used by contractors to depict a progress schedule. If critical path scheduling is required, the contractor must work within the framework established in the precontract or prebid schedule.

The architect is responsible for insuring that the contractor holds regular meetings of the subcontractors. These meetings, commonly referred to as



CONSTRUCTION PROGRESS SCHEDULE PARTIAL

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job meetings, are the key to successful adherence to the schedule. Most problems related to the project can be resolved here. The clerk-of-the-works representing the school district is present at all job meetings. The architect takes minutes of the meetings and distributes copies to all concerned. In some cases, the contractor takes minutes.

Construction Administration

After the construction contract has been awarded, the architect observes the project on-site to protect the owner against defects and deficiencies in the contractor's work. Inattention to the quality of the contractor's performance can result in chronic mechanical, structural and maintenance problems that detract from an otherwise well-designed school.

In theory, the architect turns the contract documents over to the contractor, who, in turn, performs in accordance with these documents and claims completion of the work. The architect then inspects the facility and, if required, submits a listing of deficiencies, commonly referred to as a punch list, to the contractor for correction. Upon satisfactory reinspection, the architect recommends payment which the owner then forwards to the contractor.

In practice, the best inspection is continuous inspection. Without it, errors may occur that are costly or even impossible to correct after completion of the project. It is also true that, due to the various complex specialties involved in construction, no one construction administrator can effectively verify that the contract documents are being or have been fulfilled.

According to AIA contract documents, the architect is not responsible for exhaustive or continuous construction administration. Only about 20 percent of the architect's fee is traditionally allocated for construction administration costs. This makes it difficult to maintain continuous comprehensive construction administration. The best way for a school board to insure that the necessary construction administration occurs is to pay the salary of a full-time, on-site representative from the architect's firm to perform these functions. If this is not acceptable, the school board can hire a clerk-of-the-works. This expense is only justifiable for large, complex projects or numerous small projects occurring simultaneously. A clerk-of-the-works insures that the architect has a construction administrator on the premises at the proper times and that the inspections are performed in a manner that confirms the reported results. He supplements, rather than replaces, the work of the architect's employees.

A third option open to the client is to hire a construc-

tion management firm which has expertise in the building industry and building processes. A construction manager serves as a professional liaison between owner, architect and contractor.

Payments

Payments to contractors are commonly made on a monthly basis. The contractor submits a statement to the architect, who in turn attaches a certificate of payment if the request is approved. The request is forwarded to the school district where it may be checked by the contract management unit. The request for payment often follows a time-consuming route. The district which is prompt in making payments may be rewarded with lower bids.

Withholding payment. It is common practice for an amount (usually 10%) to be retained on each request for payment. This practice is questionable since it places a financial burden on the contractor, particularly if he has completed the work on which the amount is withheld. It would perhaps be more fair to retain an amount related to work yet to be done. There is a trend toward reducing the percentage to three to five percent particularly where critical path scheduling is used. Thus the contractor may be assured a lower retained amount if he stays on schedule.

Funds withheld by the board until a certificate of final acceptance from the architect is received may be used to rectify deficient work and damages for delay in completion. In some states, labor and material claims are permitted liens of the highest priority against unpaid funds belonging to indebted contractors. Statutes occasionally require a public body to retain funds for labor and material liens. Funds thus retained are in the nature of a trust for the benefit of unpaid laborers, materialmen and subcontractors.

In the absence of contractual or statutory provisions, a school district may not withhold funds belonging to a contractor even when it receives notice of unpaid claims from materialmen and laborers. When the performance of the contractor is satisfactory, the board of education is required to make the contract payment in full. Correction of inadvertent omissions or inappropriate workmanship also obligates the district to make payments in full.

Usually the architect's certificate of approval determines the legal standard of performance. This judgment will usually satisfy the contractors and the board of education, but when the architect's judgement fails to satisfy the parties to the contract, the differences are settled by arbitration or negotiation, and finally, if agreement cannot be reached, by a court of law.

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Payment for extra work. Most building contracts provide that there shall be no payment for extra work without a written order from the architect. If the contractor performs extra work knowing that the owner insists that no extra pay will be made, he is a volunteer and his claim for an extra payment will not be sustained by the courts.

Payment in part. The owner may be dissatisfied and allege that the contractor performed defective work or that the work is not according to the contract, plans, or specifications. When the owner pays a part of the amount due, the special conditions and the intent of the parties determines the effect of the payment. Any changes in the contract must be based upon the legal standard, and each party must agree on the effect of the change before the conditions of the original contract may be discharged.

A payment of part of the contract price due of an undisputed debt does not operate as satisfaction of a contract. A different result is reached if the price or debt is liquidated or disputed. Liquidated debts are settled by the agreement of parties or by the operation of law. Part payment by the owner with the understanding by the creditor and his assent by accepting the part payment as payment in full, discharges the owner of his entire debt. When a part payment is accepted, the creditor has extinguished a duty of the owner by complete contract which is furnished and executed. If the part payment is to be made at a later date, the contract is incomplete and subject to change by either party at any time before the part payment of the creditor executes the contract as a complete discharge of duty to pay in full.

Tender of payment. The refusal by the contractor of a proper tender of money due him does not discharge the duty of the owner to pay the contractor for satisfactory work performed; the proper tender of money does prevent the contractor from seeking damages for a breach of duty by the owner to pay his obligations. A suit by the contractor to obtain the interest for nonpayment at the proper time, however, would not be allowed by the courts. Neither can the contractor enforce the surety to pay the debt because of his own act of refusing to accept payment.

Construction Management

Construction Management (CM) is a comparatively new way to get buildings built. It brings professional rather than entrepreneurial direction to the entire design and construction process. CM differs substantially from conventional project organization in which leadership is split between the architect and the general contractor. With construction manage-

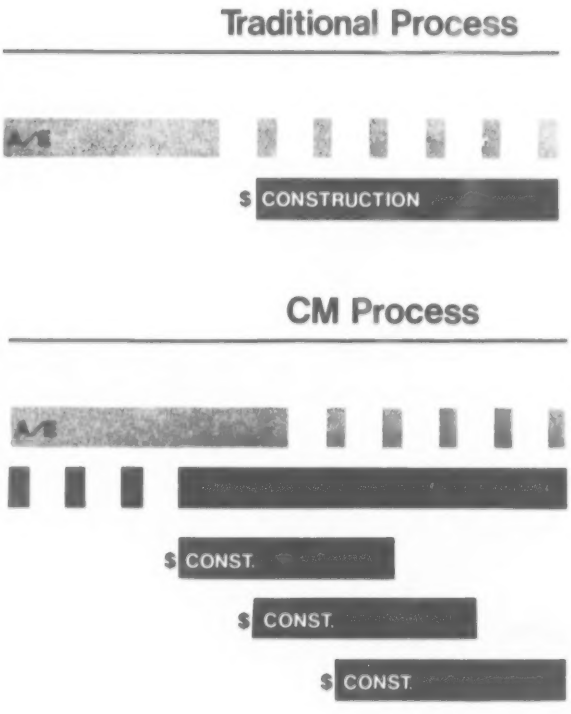
ment, there is continuity of leadership from the beginning of the project through occupancy.

The construction manager makes significant inputs relating to cost, quality and time to the architect during the design process. Competitive bidding is still employed for what are traditionally the subcontracts to the general contractor. Under CM, these become prime contracts to the owner. The various contracts may be bid at once, but are often phased or bid at different times. This is particularly true when time is short and fast-track scheduling techniques are employed to complete the project. Certain contracts are then bid in advance of others, so that work can get underway on construction elements that must be completed first.

The prime advantage of the conventional system is that the price of the project is known prior to authorization to proceed with construction. However, if bids are high, the entire process may be delayed or have to be completely redesigned because of these overages. Using CM, the various bids can be compared with budget allocations to make sure that the project is within the budget.

There are a number of other advantages to the construction management process, including the fact that bidding can be organized in packages that reflect the market conditions. In other words, bids can be taken early on certain components, combined for multiple project programs, or in the case of large projects, subdivided to make the bid packages more attractive and competitive on the market. The construction manager's job is not only to provide input relating to time, cost, and quality to the architect, but to manage construction. He organizes the schedule of construction and manages the input of the various subcontractors just as the general contractor would. General conditions on the site are either bid out to a small contractor or can be done on a cost/plus basis.

Many of the processes involved in construction management are similar to those employed by general contractors in doing work for private clients where the client is part of the decision making and the project gets underway before final prices are in on all subsystems of the building. The primary difference in construction management is that it has been employed on public jobs, in which all parts of the job are put out to bid in order to meet the legal requirements of the public agencies involved. Contractual arrangements vary a good deal, with some construction management groups favoring a guaranteeed maximum price and others not.



Drawings courtesy Caudill Rowlett Scott Architects

Design — Build

This concept combines the architect, engineer and other professionals with the builder to form a "design-build" team. In private industry selected teams are invited to submit total cost bids to design and construct a building or buildings based on a program and criteria established by the owner. Each team submits a preliminary design of the contemplated project with a cost to construct the project in accordance with the design. The client then has the opportunity to select the team and the design he wishes.

At first glance the design-build concept approach to school building construction appears to have merit. School buildings, however, are financed by public monies and must be publicly bid. Most, if not all, states require school districts to award their projects to the lowest responsible bidders as long as those contractors are able to furnish the necessary bonds. In many states multiple prime contracts are also required. Most important, stringent laws in many states require that construction documents (plans and specifications) be prepared by a distinct political subdivision.

These regulations greatly inhibit the use of the design-build concept in public school construction. School districts would be wise to consult the planning divisions of their State Departments of Education before considering the design-build approach.

N

RENOVATION, ALTERATION, CONVERSION

Before

After Condition of Main Entrance and Sidewalk
Front Entry

Before

Interior — 2nd floor corridor looking south.

After

This unit presents criteria that can be used to determine whether to renovate, alter or convert an educational facility. It provides examples of how changes can be accomplished to advantage, both economically and educationally.

It should be noted that the planning principles for new construction outlined in Unit C and Unit M can be applied to the projects discussed in this unit. In all cases, the planning should be related to well-defined educational objectives.

Old Building/New Environment

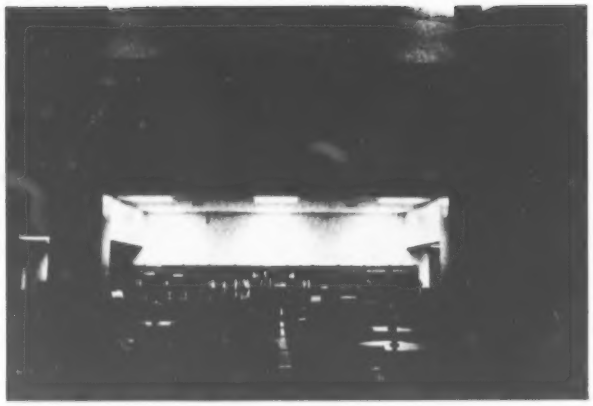
The American practice of buying-using-discarding is becoming unacceptable. Advantages of recycling not only newspaper and metal cans, but also larger components of the built environment, including educational buildings, have been clearly demonstrated. Older educational facilities can be excellent resources that should not be wasted. They represent a community's and/or university's identity. Many could be remodeled or altered to serve contemporary educational programs and to provide effective, pleasing environments for learning. An objective of renovation is to keep the best of the past while making it meet the needs of the present and future.

The importance of recycling older educational buildings arises from several realities: the high cost of new construction, changes due to high technology, and declining student enrollment. Under these circumstances, it makes sense to examine existing educational buildings to determine their serviceability and adaptability to current needs.

The energy crisis is another condition of our times that has made us look at our present facilities. They may exhibit a partial energy independence through different types of changes. More school facilities every year are becoming exemplary in their use of fuels for heating, ventilating, air conditioning and lighting the environment. All projects involving renovation, alteration or conversion should examine energy needs as a primary objective.

What is Renovation/Alteration/Conversion?

Renovation of an educational facility can involve any number of activities ranging from enlivening a drab interior through the use of paint and graphics to making major structural changes by removing walls, creating open spaces or adding new space. It can concentrate on finishes, furniture, equipment, the structure itself, or mechanical, electrical and plumbing systems. The exterior of the educational facility and/or site could be changed to affect the environment. Renovation allows the educational



Renovation — Creston High School, Grand Rapids, MI. Change from the auditorium to media center. Photo courtesy of John Sampson.

facility to maintain its primary educational function.

Alteration could involve many of the same activities as renovation but there **could** be a change in the primary function of the educational facility. It could also refer to minor changes made in the facility.

Conversion of an educational facility is a major change in the use of the facility. Many have been converted to usable space for other functions in the community, such as: senior citizen housing, municipal or office buildings, cultural centers, private schools, churches, job corps centers, or community service centers.

Determining Feasibility

Certain preliminary steps must be taken before a renovation, alteration or conversion project is started. The facility and site must be evaluated, which involves selecting assessment tools and establishing an evaluation process. Participatory planning should be considered to bring a greater commitment to the project through the involvement of those who use, build and pay for the facility.

The school district or university must be willing to undertake a feasibility study if it is to arrive at a satisfactory decision. Any study of existing facilities should include assessments in at least the following areas:

KEY POINTS TO CONSIDER WHEN RENOVATING

1. What are the educational goals of the educational system?
2. How does this facility/site fit into the overall short/long term plans of the educational system/community?
3. Can the educational facility be renovated?
   a. (structural, mechanical, electrical)
   b. (safety and accessibility codes)
4. What is the historical significance of the area?
5. What is the financial support of the project?

Assessment	Reference to Other Units
• Program support	E
• Location	F
• Structural soundness	C
• Adaptability of the building	I
• Adequacy of space	E, G
• Aesthetics/historical significance	I
• Operational and maintenance efficiency	M
• Conditions of mechanical and electrical systems	M
• Compliance with safety codes/accessibility	C, M
• Site characteristics	F
• Cost of project	K

Program support (curriculum planning). The ability of a building to support the educational program or other emergent needs, such as research or extension programs at the college/university level, is the central consideration in deciding whether or not to renovate, alter or convert a facility. Any changes made in the physical environment should enable people to relate to each other, to objects of study, to furniture and equipment and to the space itself in a manner that will promote the goals of the educational program.

If program support is the basic issue in any change decision, it is also the most complex of the issues to be considered. Conceptualizing new spatial relationships and interior treatments requires imagination, understanding of proposed programs and technical ability. A competent architect is essential for this task. Carefully developed educational specifications are a tool that the architect will find indispensable.

If it becomes apparent that a building cannot be remodeled to effectively support the proposed educational program, there is no need to proceed. Other alternatives should be considered including an alternative program.

Location. School buildings, especially those in urban areas, are sometimes ideally located. They are easily accessible to neighborhood children and public transportation systems. In analyzing the suitability of school location, the same criteria should be applied as are used in evaluating locations for new construction. Demographics, current and projected land use patterns, traffic and road conditions should be studied.

Structural soundness. It should be ascertained that the facility being considered for renovation, alteration or conversion is structurally sound. It must meet local, state, and federal building codes. Severe cracking in walls and floors should be checked. Sagging and moisture penetration are other undesirable conditions. Floor load capacities should be checked against the load requirements of proposed usage. The framework itself should be examined for sturdiness and reinforcement possibilities. The roof should be inspected. Doors, windows, floor coverings, and interior and exterior finishes are other candidates for improvement and replacement.

In most cases, a cursory visual examination is not sufficient. The building should be opened up in several places so that conditions will be precisely understood. This practice will prevent the unwise investment of money in a building that has faults which are prohibitively expensive to correct.

If walls are to be removed or any other major structural changes are contemplated, then it must be ascertained that these changes will not weaken the structure.

Adaptability of the building. There is a need today to insure that each educational facility can handle current and future educational programs. These basic questions must be asked: (1) Is the building adaptable; can it handle the proposed change? (2) Can the alteration be made without diminishing the current educational program? (3) Can the building be

altered without compromising its adaptability for additional changes in the future?

Adequacy of space. It should be determined that the space available in the existing facility is adequate for the expected occupancy and planned usage. Enrollment projections should be consulted for information on the numbers and ages of future students.

Aesthetics/historical significance. If a building is historically or architecturally significant or simply an attractive, well-built structure, efforts should be made to preserve and utilize it whenever possible. Interesting or handsome architectural features should be capitalized on in any renovation, alteration or conversion project.

If, on the other hand, the building is ugly or sterile and can be improved only through costly facelifting and remodeling, serious thought should be given to abandoning it. An important goal of educational facility planning is the creation of attractive environments for learning. The potential for and cost of beauty in an existing school should be a major consideration.

Operational and maintenance efficiency. An attempt should be made to understand what changes must be made in the existing facility to improve the efficiency of operating and maintaining it. For instance, how will operation and maintenance costs be affected by the introduction of carpeting, new wall surfaces, removal of interior doors, installation of new windows, or upgraded insulation? Benefit/cost ratios should be computed for such alterations.

Conditions of mechanical and electrical systems. Mechanical and electrical systems demand thorough analysis; superficial appraisal is risky. Wiring should be inspected and random samples of piping should be removed and inspected. Many older schools are heated by coal-fired, low-pressure steam boilers. In these cases, horizontal return lines may be in poor condition, ventilation may not conform to code requirements, and fuel may be wasted. Replacement of entire systems is normally required. It should be determined whether a new system can be installed without major building changes.

Bringing electrical systems up to code requirements is another critical and costly item. Remodeling should include, but not be limited to, provisions for fire alarms, clocks, telephones, public address system, television, and numerous electrical outlets for classroom machinery.

Existing lighting systems should be examined for

adequacy of lighting levels and efficiency of operation.

Compliance with safety codes/accessibility. A thorough review and analysis of all applicable building and life-safety codes is imperative. A common provision of building codes requires an entire structure to conform to code if any part of the structure is to be renovated or if it will be contiguous to an addition. Inspections for the possible use of asbestos in school buildings have been required in recent years. Also, Section 504 of the 1973 Rehabilitation Act requires that a facility not present barriers for handicapped persons.

Site characteristics. The adequacy of the site in terms of play and athletic areas, space for environmental studies programs, vehicular access and parking should be studied. Is adjacent land available that would permit expansion? How and at what expense could the original site be upgraded to provide desired improvements? Is the site attractive and usable by the community? Does it have the potential for energy-saving applications, such as solar?

Cost of project. Estimating costs for proposed improvements should involve the use of life-cycle costing techniques and benefit/cost analysis. Cost figures should be developed and compared for all alternatives.

Although a definitive percentage figure would be convenient to use as a guideline in deciding whether to renovate, alter, convert, or replace a school building, such a figure is elusive because of the many subjective considerations involved (for instance, attaching a dollar value to a good site or to a building that has special significance for a community). However, the Research Council of the Great Cities Program for School Improvement and EFL's "New Life for Old Schools" study suggest that when modernization costs approach 50% of the estimated costs of replacement, it is wise to take a second look at the existing building. In actual practice, this figure is generally higher.

Implementation

Once it has been determined that an existing school building should be saved and can be changed, the planning concepts and practices outlined in previous units can be implemented. The same care and sensitivity must be applied to a renovation, alteration or conversion project as to a new facility.

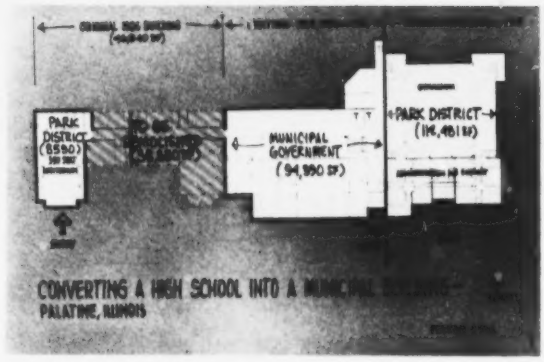
If an educational program is to continue operating during a renovation project, then a well organized plan is essential. A plan clearly indicating each

phase of the project and each part of the building affected will help contractors and educators make the best of a temporary situation. The plan must be coordinated with the building administration. In most cases, the school system will appoint an individual or hire a construction manager to work daily with the architect and contractors. This person would help resolve problems in the best interests of the educational program.

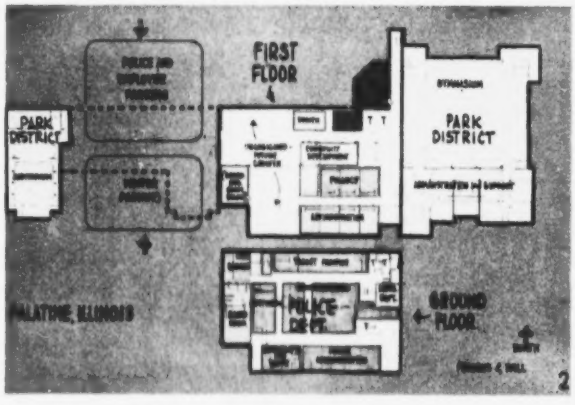
The transformation of an educational facility to a new or different use is an exciting process. An uninspiring, restrictive building can be renovated or altered to accommodate individual study as well as group learning, flexible scheduling, cooperative teaching and the opportunity for improved interpersonal relationships. Spaces may be opened by the removal of partitions. A variety of sizes and shapes can be incorporated. Carpeting, suspended ceilings, adequate lighting, new teaching surfaces,graphics and color can be applied. Courtyards and lightwells may be enclosed. A little used multipurpose area can be converted into a library/media center. Washrooms can be refurbished — new fixtures installed, doors removed and a labyrinth entrance built. New entrance doors are commonly required and justified. Improvement or replacement of windows can be functionally and aesthetically valid. Pointing of masonry and painting of trim may be worthwhile improvements. Creative use of a site can provide a learning environment, such as playgrounds and child care areas.

A careful look should be taken at furniture and equipment. It makes little sense to renovate, alter or convert a school building, change the environment, improve the atmosphere and then move the old furniture back in. What worked in the old learning stations may not work in the newly designed learning areas. Some exciting new types of furniture and equipment are available for learning stations; these offer a variety of work surfaces, storage compartments and seating. When equipping new spaces, planners and administrators should be willing to spend money, to be imaginative, and to abandon old patterns and responses.

Renovation, alteration and conversion have become such important parts of the facility picture that good examples are frequently featured in the educational journals. In addition, special exhibits of high quality changes are often a part of exhibits at conventions of CEFP/I, AASA, ASBA, ASBO, AIA, and other professional organizations.



Palatine Community Center, Palatine, Illinois. Courtesy of PERKINS & WILL.



Palatine Community Center, Palatine, Illinois
Courtesy of PERKINS & WILL.

Facilities Evaluation

A standard evaluation tool should be used in the

SCHOOL FACILITIES EVALUATION

SCHOOL _____

INSTRUCTIONAL ADEQUACY	POINT VALUE
1 Regular classrooms	_____
2 Special program rooms	_____
3 Laboratories and studios	_____
4 Gymnasium, cafetorium, multipurpose	_____
5 Media Center	_____
6 Adaptability to future programs	_____
7 Equipment and furnishings	_____
8 Program offering capabilities	_____
Sub-total	_____
BUILDING	
1 Size, capacity, and utilization	_____
2 Interior quality and conditions	_____
3 Exterior quality and conditions	_____
4 Energy cost for heating, power and lighting	_____
5 Custodial and other operating costs	_____
6 Handicapped accessibility	_____
Sub-total	_____
SITE	
1 Size of site related to size of building	_____
2 Location	_____
3 Environmental considerations	_____
4 Site development, landscaping, playground	_____
5 Community use of site and building	_____
6 Vehicular traffic patterns and accessibility	_____
Sub-total	_____
Grand total	_____

feasibility assessment process, which is important for consistent criteria.

An evaluation system can be established, with numerous factors listed and a point value determined for each factor. For example, for each factor one of the following point values can be assigned:

5 = excellent
4 = above average
3 = average
4 = below average
5 = inadequate or poor

Factors can include instructional adequacy, building condition and site adequacy. If twenty factors are used for evaluation, a perfect point score for all factors would be 100. A point score of 90 would indicate a very good school, while a point score of 45 would indicate a poor school.

The "school facilities evaluation" chart shown here can be adapted to the unique needs of the particular school district.

Converting Other Buildings to School Use

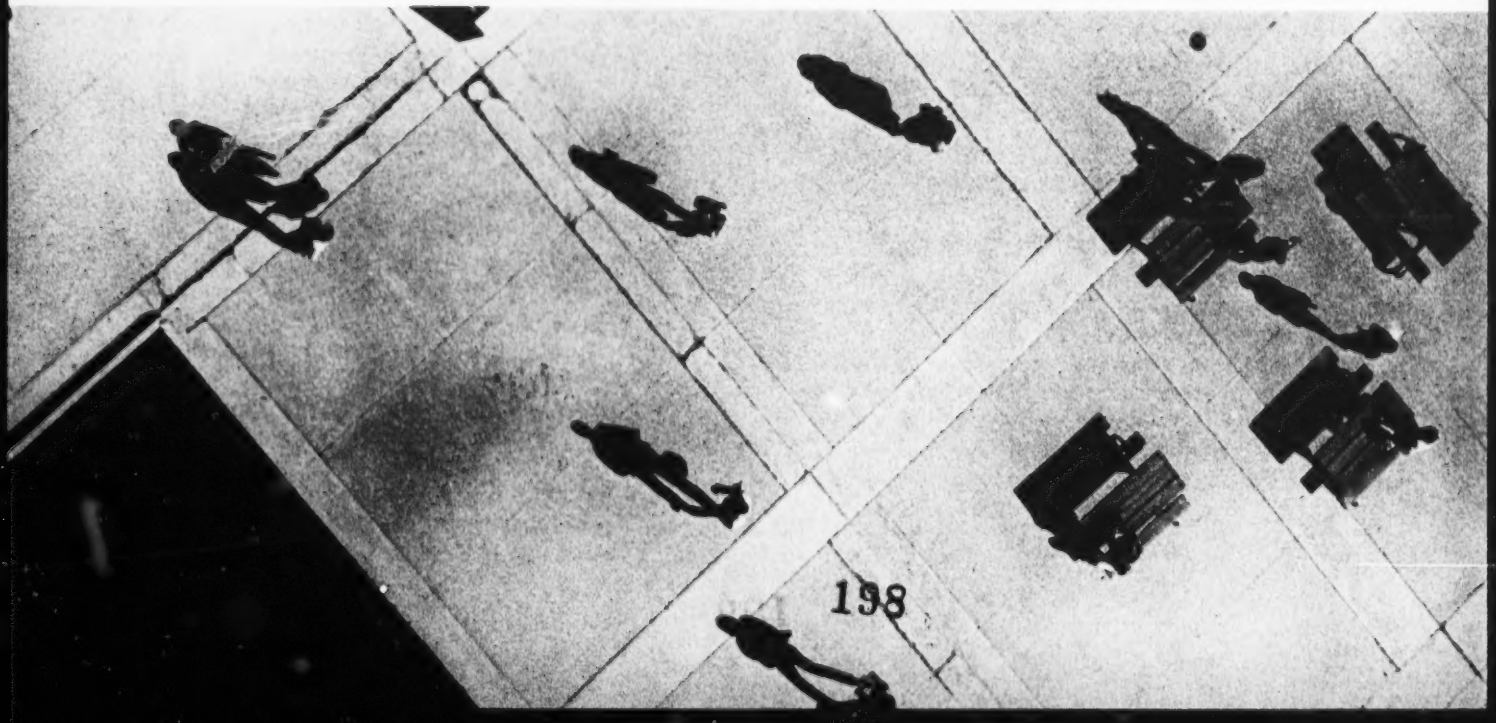
Warehouses, factories, office buildings, and other noneducational buildings should not be overlooked as potential educational facilities, particularly in urban areas. Examples of successful conversions are numerous: the University of Colorado at Denver remodeled a traction company headquarters into an urban campus; El Centro College in Dallas converted a seven-story department store into an inner-city college; Atlanta converted a former church into an elementary school; Washington, D.C. renovated a supermarket to house a preschool center; and New York City Schools turned the Old World Telegram & Sun Printing Plant into an alternative high school for dropouts.

Converting other buildings to school use today depends on the needs of a community or post-secondary school. In some areas, enrollment decreases have required school districts to find new ways to use excess educational space, not find new spaces. However, the better use of existing facilities should be a goal of every community.

O

ORIENTATION AND POST-OCCUPANCY EVALUATION

Plaza, Cleveland State University; photo by Chuck Humel Associate Architects



As a construction program (Unit M) or a renovation and alteration program (Unit N) reaches its completion, it is time to initiate the last phase of the facilities construction process. The last phase of the well organized educational facility construction process is building activation, orientation and evaluation. To those who are familiar with the systems approach to planning, orientation and evaluation is the step that completes one cycle and provides corrective feedback to the next cycle.

When orientation and evaluation are neglected, the unfortunate result is that the educational administrator, faculty and staff must face the challenges of adjusting to a new facility without professional help to smooth the transition period. The owner who helped to select the carpet may be faced with difficulties in trying to clean it. The owner who requested flexibility may be stuck with demountable partitions that he doesn't know how to rearrange. The owner who wanted innovative design solutions may be immersed in conflict because established use patterns are impeded by a new building configuration. The owner who wanted to develop a computer lab may discover that the electrical services or room climate are not as expected. The owner who insisted on rooftop heating and cooling units may discover that district maintenance personnel cannot maintain them. In this manner, the potential of many advantageous design features may never be realized because the users do not understand the purpose and ideal operation of the building. Consequently, a demountable partition that will not be moved is as inflexible as a masonry wall.

An educational facility must be congruent with ideas that are understood and supported by the users. A new environment alone will not impel change in behaviors that have developed through time and experience with other environments. If, of course, the users were involved in the initial planning stages and the design of the facility reflects their preferences and intended usage, the problem is more than half resolved. If not, simple orientation must become something more comprehensive, perhaps more like in-service training.

The orientation and evaluation phase may be completed in three stages. The first stage includes building activation—the process whereby the building is placed into operation. The next stage involves orientation of those who will live in and use the building: the building operators, the prime users (teachers and students) and the public. The last stage is the post-occupancy evaluation, which includes both a technical evaluation of the performance of all subsystems as well as a functional

evaluation of the extent to which the facility meets and serves the program objectives.

Building Activation

Building activation is the process of advancing a school building project from the static state of completion into an activated and integrated facility that functions in accordance with the design intent, the specifications and drawings, and the overall functional requirements.

During this process, individual pieces of equipment or components, as well as systems of components, are tested to make sure that they are in good working condition. More importantly, various systems of the building complex such as the architectural, structural, mechanical and electrical systems are checked to assure that they function together properly and adequately as a fully integrated facility. Records of correct performance and deficiencies resulting from this process are proof of the facility acceptability as well as a reliable data base for further evaluation.

Orientation Programs

A teacher's involvement with a facility differs from that of a chief of maintenance or a community resident. Consequently, a variety of orientation programs should be developed. Two main categories are user orientation programs and public information programs. The first is directed at the needs of persons who will work in the facility. The second is intended to promote familiarity with the school as a community resource.

One orientation tool that is meeting with growing acceptance is the user's system manual. It includes three basic types of information: (1) a summary of the project's history and the most influential design concepts, (2) an explanation of how these concepts are implemented in the actual design and major use guidelines, and (3) a maintenance and operations section giving technical data on the building systems and components, cleaning instructions, guarantees, and other vital information.

The manual should be informative rather than restrictive, telling users what was intended and allowing them to use the building as effectively as possible and in accordance with their needs. The user's manual provides a record of design decisions. It is a resource book of utilization and maintenance information to which users might not otherwise have access when the original facility planners are unavailable.

Detailed orientation sessions directed specifically at answering questions of school administrators,

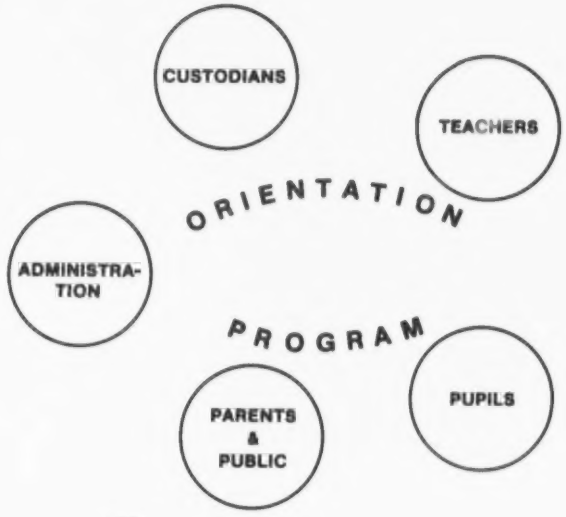


Figure 1

faculty and staff can take the form of a building tour conducted by the design team, made up of the architect, consultants and district personnel. Project background, design concepts and intended use can be explained.

In-service programs for teachers concentrate on the relationship between the facility and the educational program and the ways the building can be used to realize program goals. These orientation programs are particularly valuable when innovative educational programs are implemented. Programs should cover staff use of the entire building, including questions such as why windows should not be open when the air-conditioning is turned on.

Building and equipment review sessions allow the architect, consultants and manufacturers' representatives to demonstrate and discuss the operation and maintenance of various systems, equipment and interior elements. Review sessions help to prevent operation and maintenance problems resulting from unfamiliarity with sophisticated equipment. While the audience here is largely administrative, maintenance and custodial staff and others should not be excluded if the building operations will be part of their responsibility.

Selection of the maintenance engineer well in advance of occupancy allows this person to study the mechanical systems that are being installed. This helps the engineer gain experience with the facility and its mechanical systems and makes misuse less likely.

Public information programs are normally less detailed than are user orientations. They are designed to promote familiarity with the educational facility rather than in-depth understanding of how the facility can be used. Such programs are important for two reasons: they provide an awareness of how the tax dollar is being spent and they provide an understanding, particularly important for parents, of some aspects of the educational environment in which their children will learn. In community school situations, public information programs are of interest to a larger number of citizens because of the broader implications of programs and facilities.

The following activities will inform people about the purpose of the school and its unique design features:

- Media features (newspaper articles, radio or television programs) that discuss and illustrate the new educational facility
- Brochures with maps, photographs and text that briefly explain the design and educational

concepts

- Open house or tours conducted by students who have been briefed about the building and its relation to the educational program
- Printed material for distribution to visitors interpreting the new facility and program. The best of these handouts include photographs, cost information, design history, and explanations of special features and equipment. A building plan and a succinct explanation of various education programs can be included. Documentation of planning considerations related to building and site are also important.

Post-Occupancy Evaluation

Once the building is completed, the occupants and community have been oriented, and the program is implemented, it is time to look at the results of the planning, design and construction efforts. Post-occupancy evaluation is easily ignored. When the project appears finished and other matters are pressing, appraisal is normally not an urgent priority. However, the work of the administrator, the architect and other planners is not finished at this stage.

Although post-occupancy evaluation has no definitive methodology, it is an important activity and an essential part of the total planning process. It is often referred to as the last stage of the planning process, but it is not. The evaluation of an educational facility is a continuous activity. In recent years, it has become common practice to evaluate a facility during the first year and then at intervals through the next three to five years.

The evaluation provides an opportunity to obtain information that can be used to improve the planning and construction of future educational facilities. (Note the similarity between the types of information collected in the post-occupancy evaluation and the types of information used in development of a comprehensive facilities master plan — Unit C.) A school building's effectiveness is measured by how well the facility provides for the numerous and diversified teaching and learning activities that take place within it. The information obtained through a post-occupancy evaluation can provide valuable information to:

- determine how successful the planning of the school building has been
- determine how well the building responds to the educational specifications and the on-going educational program
- identify changes in the planning process that might be required and a plan to implement

Figure 2

ELEMENTS OF A POST-OCCUPANCY EVALUATION

Technical Elements

- **— Site**
- **— Engineered Systems**
- **— Architectural Features**
  - **— Interior**
  - **— Exterior**

Functional Elements

- **— Community Context**
- **— Building Site and Grounds**
- **— Facility Spaces**
  - **— Design Features**
  - **— Environmental Quality**
  - **— Services**

Operational Elements

- **— Safety**
- **— Operating Costs**
- **— Maintenance Costs**

them

- identify particular features of the building that should or should not be repeated in future projects
- determine the success of the design and construction elements
- identify and plan corrective measures for the school building being evaluated

Many people can participate in the evaluation. The responses of the users of an educational facility are most important. This could include teachers, administrators, students, aides, and custodial, secretarial and food service personnel. Additional participants could include the project architect, the district's facility planner, central office personnel, community members, and regional, state or federal officials. The experiences, perceptions and expectations of each evaluator are different; their input is vital to give a total and balanced evaluation of the facility.

From the input of these participants, an evaluation of an educational facility can include a systematic compilation of quantifiable information, such as student/teacher ratios, square feet per classroom or learning area, costs per square foot, costs per student, square feet per student, life-cycle economy and construction time. This information can serve as a kind of spatial inventory for the school district.

Evaluation permits a school district to assess various architectural and educational innovations, for instance, flexible, open-plan schools may be compared to schools with enclosed classrooms or with other configurations. When the evaluation is used to collect information for comparing costs, number of change orders, building schedules, and the like, the school district can form a basis for projecting costs and schedules for future construction projects. Evaluations can be used to assess the architect and to ensure that the school district specified what it needed, got what it specified, and needed what it specified. The architect, in turn, can determine if what the client said he or she wanted is actually being put to use.

Who Does the Orientation and Evaluation?

Orientation and evaluation is the responsibility of the architect and the facility planner or educational administrator most closely related to the project. The architect's responsibilities diminish stage-by-stage while the educational administrator's role increases.

The architect's prime responsibility lies in the building activation stage and in the orientation of administrators and users. The educational administrator is

involved in the building activation but assumes more responsibility as the stages progress towards the final step, the post-occupancy evaluation.

How Is It Done?

The first stage—the building activation—follows generally accepted patterns. Deliverables include not only a building that has been checked out completely but a system manual describing how the building is to operate and a set of maintenance and operating manuals for all subsystems.

Less rigorous procedures are followed in the orientation stages. The objective is to thoroughly familiarize all users with the building and its operating characteristics.

The post-occupancy evaluation is best handled by means of a suitable questionnaire or evaluation instrument. There are many types and styles of evaluative instruments and procedures available. Educational administrators can review and select an evaluation instrument from a variety of sources. Some are available commercially or from colleges and universities. Others can be obtained through national or regional evaluation or accreditation programs, or from state education agencies. Although they may vary in scoring method and format, they all seek to qualify the judgment of the evaluators and to present a report of the results.

Evaluations that are too complicated, too time consuming, or too expensive to be done regularly are not effective. An important criterion in selecting an evaluation instrument is practicality. A small-scale evaluation that is done regularly is more valuable than a prohibitively complex one. It should be recognized that the evaluator is more important than the evaluation tool; the use that is made of evaluation results is even more critical.

It should be evident that the planning process, at this point, has come full circle. The process that began with an assessment of needs and an evaluation of existing facilities (see Unit C) again resumes with the appraisal of existing facilities. If the purposes and process described in this unit are followed the building project should come to a successful conclusion. And subsequent projects are likely to be more successful as a result.

Post-Occupancy Evaluation Design Structure

Evaluation Focus

- Identify the purpose for the evaluation, i.e., what decisions are to be served eg., establishing repair and maintenance schedules through identification of needs, informing capital funding approval and allocation decisions, and design feedback for future facilities.
- Identify components and factors required to be evaluated.
- Establish evaluation standards, criteria and measurements, for both the technical and educational aspects, e.g, adequacy and suitability for educational program and instructional practices, degree of deterioration, health and safety, design weaknesses and deficiencies.

Data Collection

- Identify:
  - data sources
  - collection instruments and procedures
  - sampling and testing procedures

Data Organization

- Identify format for data collection, recording, storage and retrieval

Data Analysis

- Identify analytical procedures and outcomes

Information Reporting

- Identify reporting format and schedule

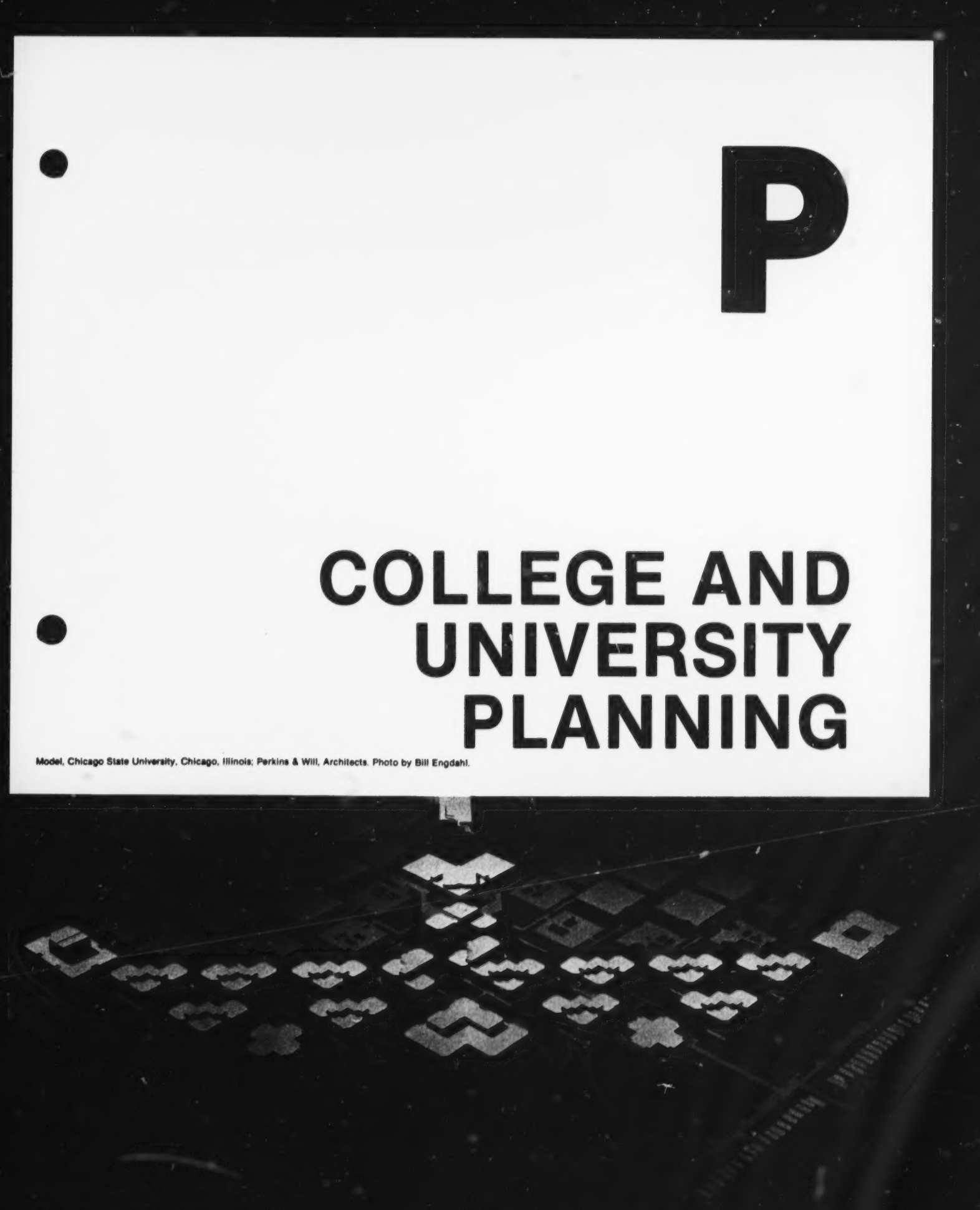
Administration

- define evaluation personnel and budget requirements.
- define evaluation policies, procedures and schedule.
- specify scheduel and means for updating evaluation design.

Figure 3

P

COLLEGE AND UNIVERSITY PLANNING



Model, Chicago State University, Chicago, Illinois; Perkins & Will, Architects. Photo by Bill Engdahl.

College and University Planning

Institutions of higher education (including two-year junior or community colleges, four-year senior colleges, and universities) present the facility planner a challenge beyond the scope of traditional elementary and secondary schools. Among those characteristics unique to higher education are varied curricula, extensive support services, student activities, housing, parking, full-line food service, health services, and others. The coordination of these factors to achieve the desired environment requires thorough planning, involving students, faculty, staff, and alumni.

Planners will encounter a variety of curricula in higher education, ranging from secondary school remedial to postdoctoral studies. These upper level educational programs significantly affect space planning needs. Nursing education is an example. This specialized instructional area, which includes health care and patient services, requires coordinated laboratory and classroom space with sophisticated media capability. The same is true of programs in agriculture extension services, mass media, museums and galleries, research, and sports.

The scope and extent of supporting services add another dimension to physical planning for higher education. Among these are library and learning resources, administration, plant operation and maintenance, health services, student records, and student and faculty housing. In addition, facilities are often provided for personal services, including dry cleaning and laundry, post office, banking, and personal grooming. Colleges and universities also operate auxiliary service enterprises such as printing, transportation, food warehousing and processing, carpentry, electrical, upholstery, refrigeration, and lawn care.

Co-curricular and extracurricular student activities are varied and extensive in higher education. Two main factors, a diverse population and a large amount of on-campus discretionary time, intensify the need for planning adequate facilities for students. Most universities provide a student center or union to house a variety of activities. Spaces for meeting, lounging, studying, games, arts and crafts, and similar activities must be considered in the planning process. More recent innovations affecting planning are the recreation complex to serve an entire campus and small centers serving clusters of dormitories. These complexes are specifically designed for student use of leisure time. They must be planned to accommodate a variety of individual and team games and exercies, oftentimes on a twenty-four-hour schedule.

Other factors unique to higher education have an impact on physical planning. Enrollment, for example, is voluntary and subject to shifts in social and economic trends. As a result, projections of student count are difficult. Facility planning is also affected by program choice after enrollment and by the proportion of full-time and part-time students and commuting students. These factors affect food service, parking, recreation, housing, health services, and lounge and study areas.

The context of higher education presents unique variables for the facility planner. In many ways, colleges and university campuses are like cities. Planning facilities and related areas to meet the complex needs of higher education presents the professional planner with many opportunities for creative solutions.

Educational facility planning for higher education is normally termed campus planning. Campus planning deals with a series of buildings, including landscaping, zoning requirements, access, parking, utility systems, security, and auto, pedestrian, and two wheel vehicular traffic.

In addition, recent pressures of declining enrollment and shrinking financial resources have forced institutions to pay increased attention to energy conservation and life-cycle costing. These elements must interrelate to create an entity known as the campus. The objective of campus planning is to produce a smooth interrelationship among these elements to create a functional efficient unit that is environmentally and aesthetically appealing. To accomplish this, the campus planner must use the methodology of the professional educational facility planner, with assistance from the urban planner, structural and landscape architects, designers, civil engineers, graphic artists, and specialists in capital financing and budgeting. Campus planning has come to be an accepted and important function on campuses around the world.

Typical Concerns

Land use and zoning. The land and its capacity for development represent the first and most important determinant of the overall campus plan. The quantity of land available affects many aspects of the campus plan, including (1) the intensity of building development, (2) the type of parking system to be employed, (3) the circulation pattern, (4) the availability of resources to support

areas such as housing, (5) research and other nonteaching functions of the university, (6) the kind of programs that can be offered, and (7) the enrollment.

Land use represents the primary development guidelines on which all other elements of the campus plan are built. Campus land uses are normally divided according to the principal academic and support activities that characterize the campus itself. Major land use categories encountered in a typical campus plan include: (1) building sites, (2) teaching and research, (3) recreation fields and courts, (4) intercollegiate athletics, (5) parking ramps and lots, (6) agricultural production, (7) streets and roads, (8) airport, (9) campus areas, and (10) investment property.

There are many ways in which these individual land use elements can be organized in developing the plan for an individual campus. The choice of patterns will be influenced by the historic development pattern of the campus, the academic mission and role of the institution, the academic plan itself, and the time-distance relationships between key facilities on the campus. These concerns must be examined on an individual basis with particular regard to the unique characteristics of each college or university.

Campus access. Access has become an increasingly important element in the planning of the campus. Even the traditional, older schools have become more oriented to the movement of people to and from the campus, and many new institutions, particularly the community colleges, have become commuter schools dependent almost entirely upon access by automobiles.

The campus circulation system must be properly coordinated with the overall transportation system serving both the community and the region. The failure to achieve a proper integration not only will hurt the functioning of the campus, but also can lead to conflicts that will be a source of continued aggravation dividing the campus from its host community. The question of access to the campus cannot be dealt with by the university in isolation. Cooperative planning among the university, its host community, and the regional or state transportation agencies is absolutely essential if a well integrated, smoothly functioning access system to the campus is to evolve.

Circulation systems. Circulation on and around the campus must be considered. In campus

New Performing Arts Center, University of Texas at Austin; photo by Larry Murphy

planning, circulation includes movement of vehicles, pedestrians, bicycles, and service equipment.

In planning vehicular circulation, the ideal situation typically is to create: (1) a ring loop in which traffic will move about the periphery of the campus; (2) a series of penetrators to allow traffic to move from the ring road to destinations on campus; and (3) a series of minor campus streets to allow for servicing and maintenance of facilities. In many cases the ideal situation is not in place, and planners must work to adapt the existing system to approximate the ideal. It is often necessary for the planner to work cooperatively with municipal authorities in order to implement an effective vehicular circulation plan.

Circulation planning is a discipline of its own in the field of traffic engineering. Detailed issues such as roadway design, operations, signals and intersection design should be handled by professional traffic engineers. The input of these experts in the production of the overall campus plan is important if a truly workable system is to be developed.

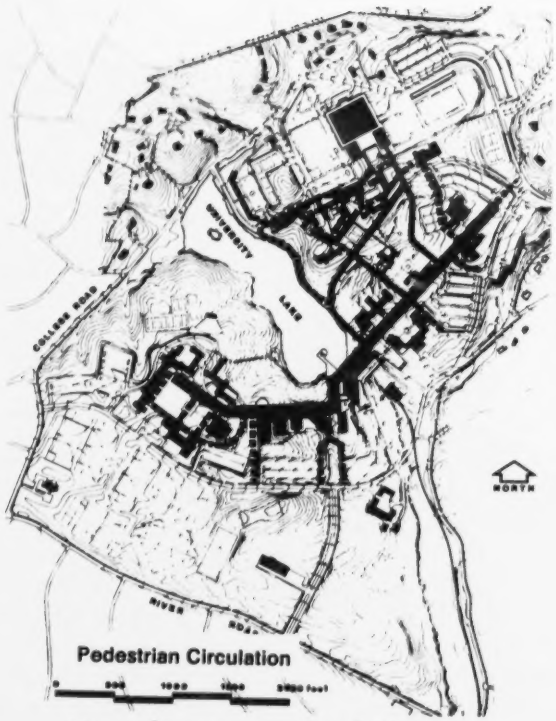
The pedestrian circulation system is one of the principal exterior design elements that tie the campus together. It has constant and significant impact on users and visitors to the campus. Careful planning and design of pedestrian patterns should be a major consideration in campus planning.

A pedestrian circulation system normally includes:

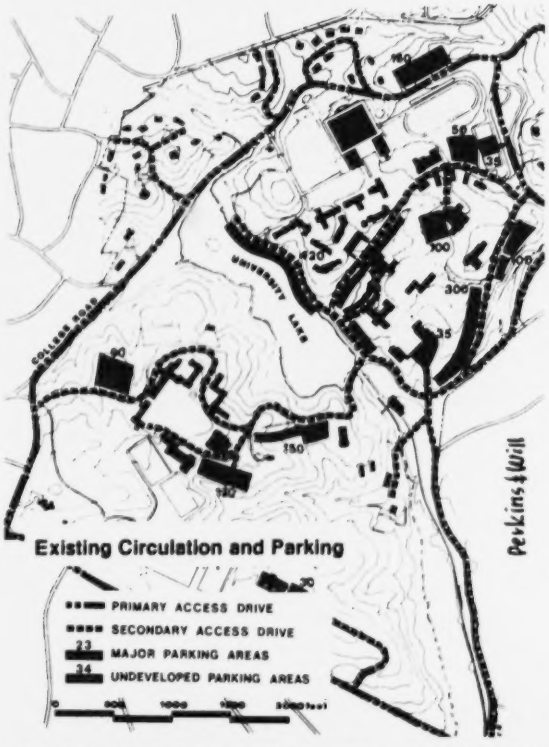
1. Major plazas or squares (gathering points and transition areas between buildings and other elements of the walkway system)
2. Major pathways (carrying the heaviest volume of pedestrian traffic
3. Major intersections of pathways
4. Minor pathways

The issues of layout, walk materials, width and placement, scoring patterns, and maintenance must all be considered in designing appropriate walkway systems.

Bicycles have long been a major means of transportation on university campuses and in university communities. With the growing cost of energy, their popularity among students and faculty is increasing. Proper accommodation of the needs of bicyclists should be addressed in the campus plan. Where buildings are well spaced and there is a relatively generous amount of land



Example = University of Richmond



CAMPUS CIRCULATION SYSTEMS

area on the campus a separate bicycle path system may be established. This has been done at the University of Illinois and at Michigan State University. In some cities, such as San Francisco, a separate bike network has been established on the city street system that allows movement to and from the campus by means of already established streets. In other cases, the pedestrian walkway is combined with bicycle circulation. Any of these systems can work effectively if properly planned and designed.

Bicycle storage and security are also important considerations. A wide variety of bicycle racks are on the market today, and each campus must evaluate the various systems to determine which is most appropriate for the campus.

Access for service equipment must be provided to every building or group of buildings on the campus so that goods may be delivered and waste material removed as part of the day-to-day operation of the university. This can be done using the normal roadway circulation system, special access service drives, or a portion of the walkway system. All of these solutions have been employed in various places and have been made to work effectively. Each campus, however, must study its own needs and operating characteristics before determining which solution might be best.

Parking. No other area of concern in campus planning gives rise to so many problems and so much controversy as does parking. Planning for adequate parking, like circulation planning, must rely heavily on the expertise of people from the field of traffic engineering and parking management.

The basic methodology to be followed in determining the parking program for the campus can be outlined as follows:

1. Estimate the demand for parking space.
2. Determine the space required to accommodate the demand.
3. Decide management issues, such as priorities for student, faculty, staff and visitor parking.
4. Develop a plan.

Most parking programs turn out to be a combination of corrective measures to deal with existing problems on the campus and the addition of new spaces generated by such developments as increases in the campus population and changes in parking standards. Although some campuses do an excellent job of accommodating parking demands, the parking problem is typically one that is never totally solved. The best an institution can do is to shape a rational and well-conceived program that meets parking demands as established by the best data available at the time.

Utility systems. An essential, yet often neglected, element in planning of any campus is the utility system. The major utility systems include heating and air conditioning, electricity, gas, water, sanitary sewage, storm water or drainage, phone and telecommunications, and trash removal. While it is not necessary for the campus plan to do detailed engineering of the various systems, it is important to assure that a proper network of distribution lines is provided for in the planning and that the network does not impede the development of major campus buildings or other surface features. It is also essential to assure that the capacities of the various systems and the demand of the campus for service remain in balance.

In this era of energy consciousness, many campuses are investigating the use of environmental controls, which can regulate the consumption of heat and conditioned air in buildings from a central source in response to the actual needs of the building. These computerized controls can be applied not only to the air conditioning and heating system, but also to other systems such as electricity and building ventilation.

The coordinated development of the utility system and the circulation system and major building elements affords the opportunity for achieving real economy in the development of the campus and, therefore, should become an essential part of any well-conceived campus planning program.

Richland College, Dallas, Texas;
photo by John Rogers

Ecology. Ecology is the study of interrelationships between organisms and their environment. Applied to campus planning, it is the investigation and application of sound principles to the interrelationship between built systems and natural systems to ensure a campus in harmony with nature, yet able to meet the needs of human users.

The following must be considered: landscape quality, the links between development and vegetation removal, run-off and waste disposal, noise containment, and the provision of useful spaces for people. The question becomes one of preservation, modification, and change.

Aesthetics. A major concern in campus planning is the maintenance of an environment that has aesthetic appeal throughout. Some of the questions to be raised are:

1. Is the campus organized on the basis of quadrangles, major axes, or other geometric forms that will affect planning decisions?
2. To what limits can buildings rise or spread without adversely affecting the form and function of the campus?
3. How does the campus join surrounding areas?
4. What are the implications for the aesthetic quality of existing or proposed pedestrian and vehicular corridors?
5. Do the furniture and equipment in buildings form an element of continuity across the campus?
6. How can sculpture, fountains, and other art inclusions be introduced to create special aesthetic appeals?
7. What plant and other landscaping materials can be used to promote unity and the aesthetic quality of the campus?

Planners must deal with these concerns in the context of each individual campus. The appropriate solution to these problems is of prime importance if the campus is to embody a high quality of aesthetic appeal.

Building code regulations and other requirements. The university must function within the framework of a variety of governmental regulations and limitations affecting the physical development of the campus. At the local level, these can include zoning ordinances, building codes, demolition requirements, soil sedimentation ordinances, and landscaping requirements. State level limitations might include fire protection codes, handicapped codes, and life safety codes, while the federal government might enforce lab spacing requirements, hospital certificate of need requirements, and occupational health and safety standards. Outside government, other requirements may be imposed by the tradition of the institution, donors, or other external agencies. All of these elements are important factors that must be taken into consideration if the plan is to be a realistic and effective means of shaping the future growth of the campus.

Process and People

A successful campus planning program requires two basic components, namely, people and a well-defined planning process. In a dynamic institution with constantly changing programs, a continuous planning mechanism must be in place and working. Conversely, if any planning system is to be effective, it must have the expertise and general support of the entire campus community. Failure to recognize this interrelationship is to seriously jeopardize the quality of education provided students. A finely tuned system for planning provides the best today and felxibility to continually adapt to certain change.

Process. Campus planning can be viewed as a five-step step process that includes: (1) analysis, (2) goal-setting, (3) plan development, (4) plan implementation, and (5) evaluation.

A careful inventory and analysis of existing conditions on the campus is the starting point for future development. Among the variables to be considered are: (1) environmental features such as topography, soil, hydrology, vegetation, and land forms; (2) the number, functionality, and condition of existing facilities; (3) land use, circulation systems, parking, utilities, lighting, and signage; and (4) regulatory factors, including regional and local master plans, zoning, historical districts or buildings, and alumni priorities. This kind of information provides the base from which to examine future development.

Institutional goals must be specific and measurable if they are to be statements around which campus planning can be built. Academic goals should include programs, enrollment projections, faculty teaching responsibilities and conditions of service, and support programs. Goals to provide for the nonacademic needs of the campus should be developed in the context of full support of the institution's prime responsibility, teaching and learning.

The plan development phase sets forth recommendations considered in terms of the

proposed goals of the institution. Programs and enrollments will determine building requirements in terms of square footage and student stations. This will in turn define the location and number of parking spaces, road locations and load capacities, pedestrian circulation, and service requirements. Plan development will also consider the aesthetic and ecological environments and the realities of financial resources.

The plan document should be complete and should include lucid descriptions; drawings, when necessary to better explain and illustrate; and a narrative giving the rationale underlying major decisions. The document should be viewed as a proposed guideline and as an instrument for public relations.

A realistic process for implementing the campus plan should (1) provide for phased development, (2) strive to achieve a finished look to the campus at all phases of development, and (3) provide consideration of the displacement of people and programs in renovation projects and the consequence of construction on the daily life of the campus. Coordination and communication are essential elements at this stage of the process.

The evaluation phase permits the planners to determine whether or not the program is carrying out the guidelines set forth by the master plan and whether or not the process is meeting the goals and objectives set forth in phase two of the planning program. Evaluating the planning process will involve considerable interaction with others, including administrators, faculty, students, the community, and alumni. Responses can be used to modify or refine the process and provide a base for future planning and development.

People. Successful planning for higher education requires the involvement of people. An easy way to meet this responsibility has not been found. The person responsible for coordination must become a student of participatory planning if the institution is to achieve quality. There is no substitute. The college or university professional planning staff has the responsibility for coordination and for production of the planning document. Assisting are the institutional planning committee and special consultants.

The in-house staff can range from one campus planner to as many as fifty or sixty people at a major university. The size of the staff is not important. Results based on a consistent planning process and ideas generated by people working together are critical elements. The in-house staff usually undertakes the following duties:

1. Intelligence function (measuring and evaluating existing activities and physical plants; predicting the effects of physical changes on curricula, institutional goals, and enrollments)
2. Community relations function (those studies, communications, meetings, and measures necessary to coordinate institutional and community growth objectives)
3. Programming function (identifying development problems, posing alternative solutions, preparing documents to ensure that project designs will reflect long-range development policy)
4. Physical plant development (preparing capital improvement budgets and preliminary and final project plans, supervising construction)
5. Secretarial function (keeping all records, documents, and other materials necessary to carry out planning, programming, and physical plant development)

Institutional planning committee. The institutional planning committee is a common channel for input into the planning process. It should include executive officers, academic deans or department heads, maintenance and operations personnel, faculty, student officers, and alumni. The size of the group should lend itself to operational efficiency. An open channel of communication to the chief officer of the institution is imperative.

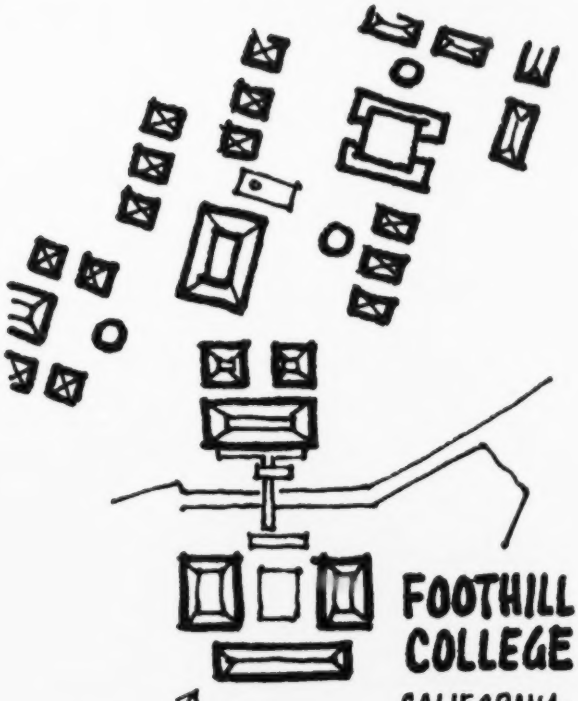
The role of the institutional planning committee is to review, propose, and advise. Specific activities are to review existing conditions, to assess and verify needs, and to establish priorities for the quantity and quality of facilities and related service. The group advises the administration of its priorities and works to communicate with the larger campus community.

Consultants. Consultants are a major source of assistance in developing and implementing a campus plan. The consultants may be campus planning specialists, architects, designers, or traffic, parking, civil, mechanical and electrical engineers.

Summary

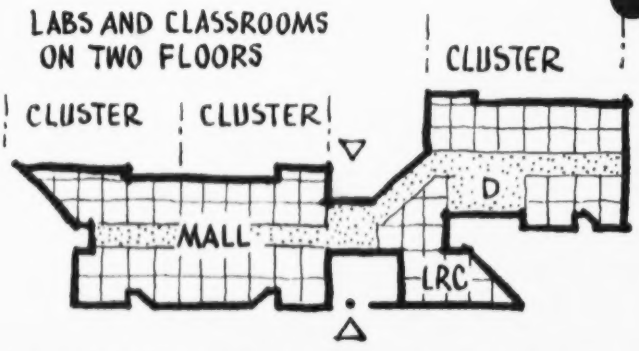
Educational facility planning for higher education is normally termed campus planning. Typical concerns of the campus planner are land use and zoning, access, circulation systems, parking, utility systems, ecology, aesthetics, building codes, and the requirements of tradition. The

COMMUNITY/JUNIOR COLLEGE PLANNING



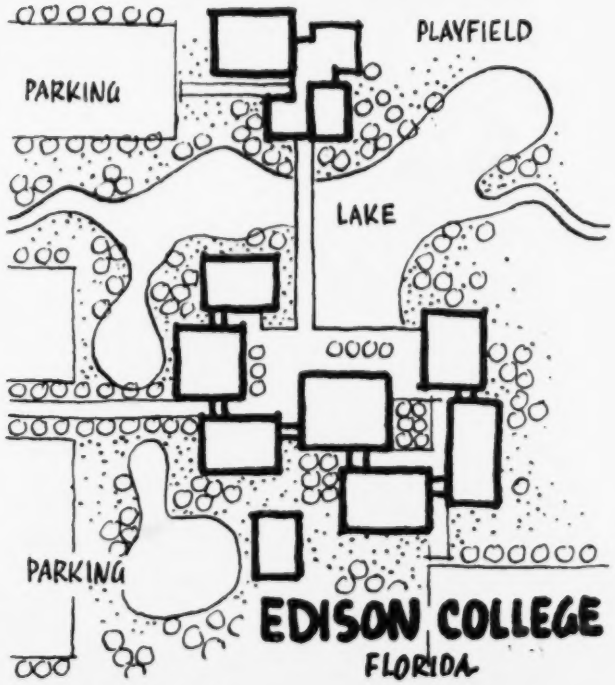
FOOTHILL COLLEGE
CALIFORNIA

Separate buildings – where climate encourages outdoor circulation.



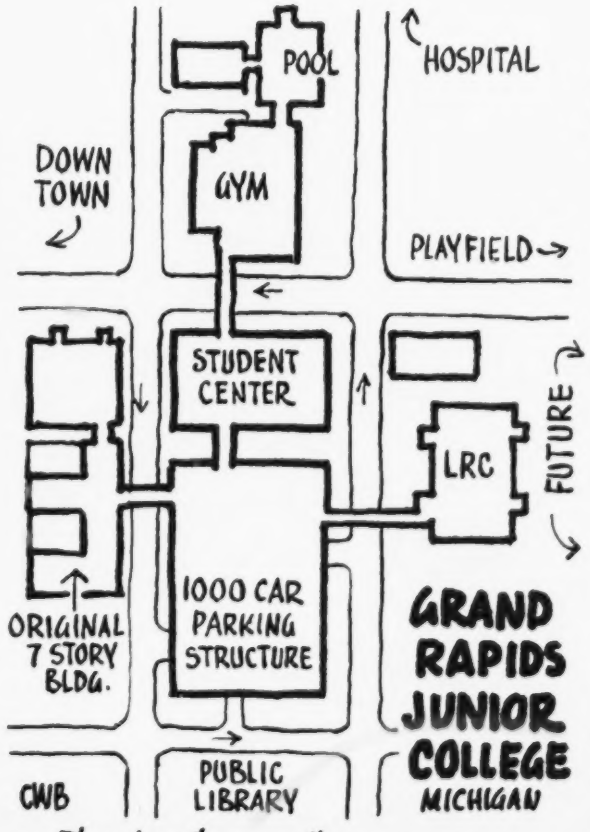
OAKTON COMMUNITY COLLEGE
ILLINOIS

All facilities in a single building along a student mall.



EDISON COLLEGE
FLORIDA

Linked buildings ... for convenience ... but allowing for incremental growth.



GRAND RAPIDS JUNIOR COLLEGE
MICHIGAN

The downtown college campus ... allowing for growth in stages ... with pedestrian bridges over city streets.

P-8

planner must coordinate these components to achieve a functional and efficient unit that is both environmentally and aesthetically pleasing.

Campus planners will encounter variables unique to higher education. Among these are the variety of curricula, extensive support services, co-curricular and extracurricular programs, fluctuating enrollments, and varying proportions of full-time and part-time students. The context of higher education is not unlike city planning. Planning facilities and related areas to meet the complex needs of higher education presents the professional planner with many opportunities for creative solutions.

A successful campus planning program requires two basic components, namely, people and a well-defined planning process. The process includes analysis and goal setting, plan development and implementation, and evaluation. Cooperating in the production of the campus plan are the in-house institutional planning staff, the institutional planning committee, and special consultants. The product is a plan to provide maximum facilities and services to enhance the learning process.

Q

BUYING, SELLING, LEASING

Martin Luther King High School view from Lincoln Center.
Photo Courtesy of Frost Associates, Architects.

This unit deals with the management of capital resources through buying, selling and leasing educational facilities. The procedures presented here deviate from the traditional method of acquiring a building by a governing board or a college/university (i.e., hiring an architect to design a building, submitting it to the bid process, and constructing it).

Buying, selling or leasing property for school use can be complicated. Building codes and legal, funding and public relations issues must be considered. But long-range planning, community involvement, open communications, a little vision and a lot of common sense can make these options a successful use of educational capital.

Buying

Rationale. The outright purchase of a building by a board of education or board of trustees for use as an educational facility is not a frequent occurrence compared to the usual process of constructing facilities. However, it is one option that should not be overlooked.

There are compelling reasons for a board to acquire a building through purchase. It might be, for example, that a facility is needed immediately and an appropriate non-school facility is available. Opening a school is good utilization of a surplus facility, particularly if it is surplus to another branch of government. Given the same immediate need, a board might get faster results by commissioning a private firm to construct a building to be purchased by the board upon its completion. But comparative studies indicate that a purchased building may be considerably less expensive than one acquired through the traditional process. Whatever the reasons for the purchase of a building by a board of education, the building must, by the time of occupancy, meet the building codes in force in a given province, state or local community.

The Seller. There are several persons, firms and agencies who will sell a building to an educational governing board.

Units of government at local, state, provincial and federal levels can sell buildings to each other. This has been especially true when a building becomes surplus to a particular governmental function. It is not uncommon for a municipal government to sell its companion board of education a facility when it can be renovated to code compliance. The state and federal governments can do the same if the code conditions are met.

Private developers can sell facilities to a school district and college or university. They can be commissioned by a board, or they can "market" a building

that is already in their inventory or that they would be willing to build to specifications. As with other purchased buildings, codes must be met. A special type of private developer is the design-build firm that can provide a building to a governing board, with limited input. A design-build firm may include architects, engineers and construction contractors as its principals.

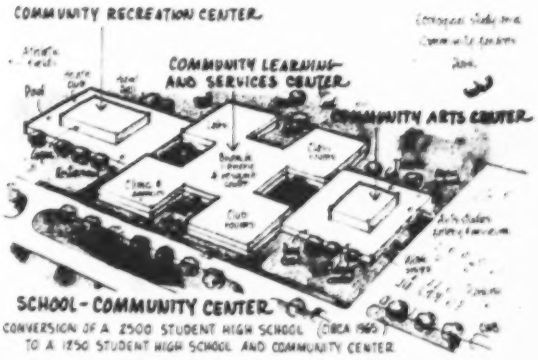
A bonding authority, with legal status in statute, can also sell a building to a governing board. Such an authority is usually created only to provide school facilities. It is described in more detail later in this unit.

Funding. The legal provisions for acquiring sufficient funds to purchase a building are varied, as is the case with many laws concerning facilities. However, there are general aspects to funding such a purchase.

The sources of funds do not differ significantly from traditional sources. Bonds can be sold for the purchase of a facility. The constraint in many instances is statutory in that bond sales are only allowable for facilities provided through the traditional procedures. The debt for a purchased facility can also be paid off from annual allocations in a district's current expense budget. The constraint here is that, in states and provinces where building aid is paid to local boards of education, the aid is sometimes lost because the budgeting amount is in current expense accounts and not in debt service or debt principal accounts. It is a matter of fiscal strategy similar to that discussed in the section on leasing. Although it occurs in rare instances, a district can also purchase a facility with accumulated budget surpluses.

Joint occupancy. Joint occupancy is the cooperative use of a facility by multiple public agencies or by public and private agencies together. It offers another way for a school district to buy a facility and provides a sound fiscal argument for doing so. Although joint purchase of a building is rare, some large urban districts have entered into an agreement for joint purchase and occupancy. Pre-planning ensured both agencies that their activities were compatible. Two such compatible mixes are school and office use, or school use and housing.

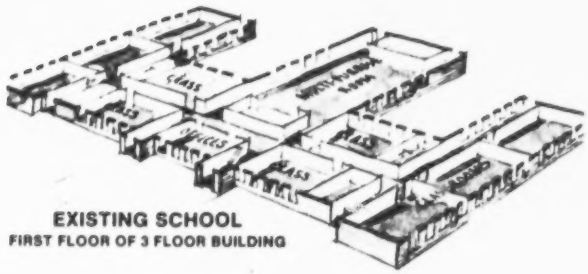
Often a private owner has contracted for the construction of an entire building and has sold the district its portion. This arrangement has potential for savings. In other instances, the contract has been a cooperative purchase venture and resulted in savings. The costs of certain portions of the building were shared because their use was shared, such as


COMMUNITY RECREATION CENTER
COMMUNITY LEARNING AND SERVICES CENTER
COMMUNITY ARTS CENTER
SCHOOL - COMMUNITY CENTER
CONVERSION OF A 2500 STUDENT HIGH SCHOOL (CIRCA 1960)
TO A 1250 STUDENT HIGH SCHOOL AND COMMUNITY CENTER

C.U. Brubaker Study, re-programmed 1960's high school

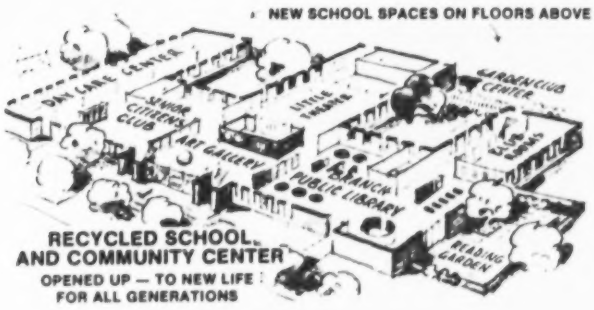
Q-3

Before = Existing School



EXISTING SCHOOL
FIRST FLOOR OF 3 FLOOR BUILDING

After = Recycled Schools Community Center



RECYCLED SCHOOL AND COMMUNITY CENTER
OPENED UP — TO NEW LIFE FOR ALL GENERATIONS

parking, recreational facilities and performing arts areas.

An even more financially beneficial arrangement results when a district owns the site, especially if the site is in a prime location and/or has a high per-acre cost. The district can lower its construction costs by allowing the private agency/company to construct a building for joint occupancy on the site. This has also occurred in urban districts. However, some smaller, suburban districts have had schools constructed at no cost to them by providing the site on which the private company builds a school as well as its own facilities.

Joint purchase of a building for the purpose of joint occupancy is not common because of legal constraints. Building codes for schools are often more stringent than for other types of buildings. As a consequence, school buildings often cannot be part of a jointly-occupied building. Another problem is that tougher codes create higher construction costs, which could restrict the involvement of private agencies. Lack of compatibility of use by the school and private owner is yet another constraint. Finally, there is the traditional view of the American schoolhouse, particularly upheld by the parents of students. To have their children attend school in a building that serves other functions has not been widely accepted by parents. Parents of college students may share this traditional view in terms of a campus and its buildings.

The objects of buying. Boards that have purchased buildings can put them to various uses. Obviously, one such use could be as an educational facility, such as a regular elementary or secondary school. Other buildings have been used for vocational or special education. Still other buildings have been purchased for special purposes, such as administration or athletics. As long as a purchased building meets construction code where necessary, it can be used for nearly any purpose.

Selling

Rationale. Of the many reasons for a board to sell a building it owns, three are most likely: (1) a change in enrollment, (2) the age/condition of a building, and (3) its retention as a capital resource.

When decline in enrollment is pervasive, the best course of action is usually the closure of one or more buildings; if decline is limited to a specific neighborhood or section of a campus, different decisions can be made. In either case, buildings can be identified for closure and sale.

The age/condition of a building raises two issues. First, the building no longer may be healthful and

safe. Many states require these criteria to be met in a variety of ways, and a building, often because of its age and a lack of proper maintenance, becomes too expensive to renovate into a safe and healthful condition. Second, the building may no longer support the educational program. Age usually will be a factor in this case, also, and a decision will be made to abandon the building for sale.

These two reasons often work in concert. A declining enrollment can result in less demand for space which, in turn, permits the divesting of old, unsafe, educationally inadequate buildings. A caution is offered here. Declining enrollment can indicate the closure of a building to be a sound management decision. However, given the successful closing, it does not always follow that the sale of the school is the best course of action. Future enrollment has to be considered in terms of facility needs. For the purpose of this unit, it is assumed that the decision has been made to close and sell a building or buildings. (The decision-making process is addressed in Unit C.)

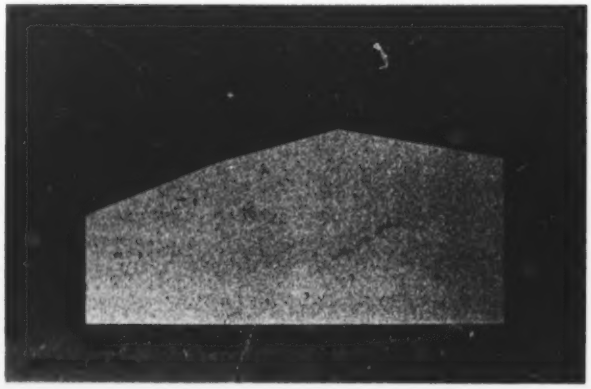
The third reason, as indicated, is concerned with the management of an educational building as a capital resource. Each building was constructed for a well-defined purpose. As long as the building is being used for its intended purpose, it is a capital resource to be valued. However, if a school district, college or university no longer has a use for a building, to retain it amounts to poor management of capital resources. It should then be considered as available for sale.

Process. The process of selling a building is well regulated in the various states and provinces. As a first step, a governing board will declare a building to be surplus based on appropriate demographic and facilities studies. They will then decide on the manner of disposition. Such action is usually taken in public session.

These steps may occur before the actual sale: (1) property valuation, (2) prospective development, (3) bid advertisement, (4) bid opening, (5) selection of buyer, and (6) property settlement. For assistance in the process it has become common to list a building with a realtor.

Property valuation is usually done by a qualified real estate appraiser. Some laws require that several valuations, perhaps three, be solicited from different appraisers. This is to assure that the owner will receive a price for the building that is at market value or close to it. The valuations are often confidential and may be used by the owner to establish the minimum selling price. Some prospects and/or bid

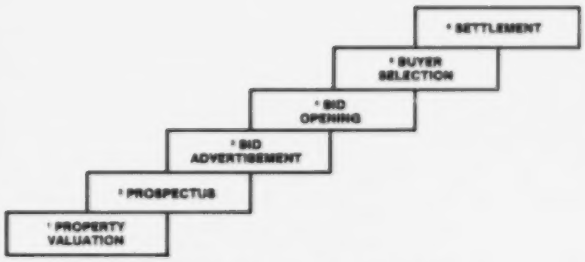
Elementary and Secondary Enrollments



advertisements will include the minimum acceptable price. Most potential buyers will have their own valuations done and will establish the value of their bids accordingly.

The careful development of a prospectus can enhance the sale of an educational building—in dollars bid, in the level of competition among potential buyers and in a quick turn-around time. The prospectus should cast the building in the most favorable light possible. It should provide information about the building's age, type of construction, heating-cooling plant, maintenance costs, general condition, degree of interior flexibility, historical value, site, neighborhood, zoning allowances (and zoning reservations), traffic patterns and other positive factors that truthfully represent the building. After reading the prospectus, the reader should want to visit the property and, ideally, submit a bid.

The bid advertisement often contains a summary of information offered in the prospectus. It generally contains, however, some very specific information about the building, such as: (1) location and zoning status, (2) size, (3) specific facilities included, (4) site size including parking facilities, (5) date and place of receipt of bids, (6) date and place of bid opening, (7) format of official bid document, (8) minimum acceptable price, (9) performance bond requirements, and (10) a contact person of the owner. The owner's attorney is a valuable resource in the preparation, review and even approval of the bid advertisement document. As previously indicated, states and provinces may differ but laws commonly require that advertisements be placed in a local, and sometimes a regional, newspaper at least two weeks prior to a bid receipt date. Experience has shown that the longer the period between bid advertisement and bid receipt, more and higher bids will be received.



STEPS TO SELLING PROCESS

A bid opening is a common occurrence in school districts, colleges and universities. Bid openings for the sale of buildings present no new challenge. Bids received before the established deadline are opened, checked for inclusion of all requirements, read aloud, and accepted for review and later decision-making about the selection of the buyer. Staff experienced in managing bid openings should be in charge. Although it varies by practice, the presence of the bond attorney may be desirable.

An evaluation of the bids received will result in selection of the buyer. Selection criteria, established prior to the receipt of bids, should include such factors as: (1) satisfaction of all requirements of the bid, (2) evidence of the fiscal solvency of the

bidder, (3) knowledge of the new use that the buyer has for the building relevant to its effect on the neighborhood residents or campus, (4) adherence to zoning laws, and (5) amount of the bid in relation to all others received and the announced minimum acceptable prices. Of course, if the law of a given state or province requires that the highest bid for an acceptable reuse of a building be accepted, then that part of the bid evaluation is fixed. In any case, the owner has to accept a particular bid or reject them all. If the latter occurs, bids can be readvertised if desirable.

Given the selection of a buyer, the only major step remaining is a legal settlement, or the transfer of ownership of the building from the seller to the buyer via an agreement of sale. This step requires the transfer of deeds and the payment of the bid price. The governing board of the seller is now free to consider how it will use the proceeds from the sale of the building.

Use of proceeds. As with all aspects of selling property owned by a governing board of a district, college or university, state and provincial laws provide the specific governance. There are a variety of uses to which proceeds from the sale of a building can be put.

A board, for example, may decide to use all or a portion of the proceeds to cover current budget operating needs. Also, it may decide to dedicate all or a portion of the proceeds to the revenues supporting the next fiscal year's operating budget. Both are sound uses for the proceeds. However, it is a common requirement in the case of a school district that voters approve a transfer of capital funds to current operating revenues. A referendum is required except when a board of education is fiscally dependent on a municipal governing body, in which case that body can approve such a transfer.

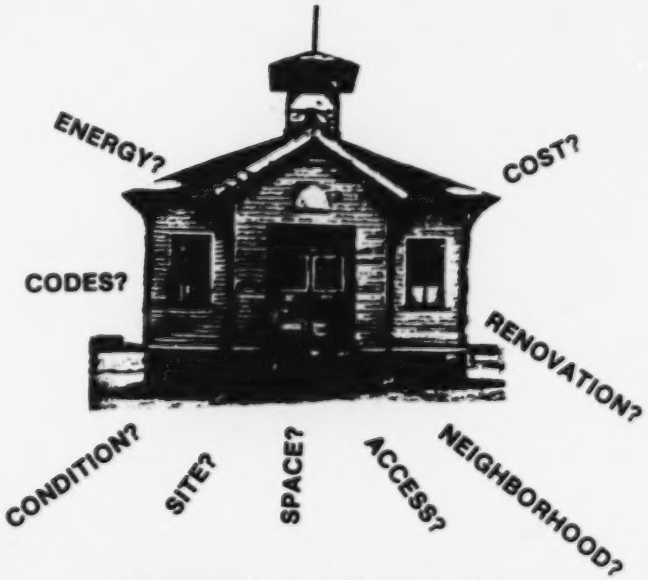
Proceeds from a building sale can also be used to support other capital projects that are underway or planned. State laws should be carefully searched to determine whether the voters have to approve such use of the funds. It is often argued, again in the case of a school district, that voters should approve all construction, even though a board of education may have amassed sufficient funds, because any new building represents an operational expense that will affect future budgets. Municipal government approval also may be required in this case, if the board of education is fiscally dependent upon it.

Owners also have the option of investing the proceeds from a sale. The earnings then can be applied to the two uses described above. The earnings, if

BUDGET

School building in use as a college.

Schoolhouse Apartments, Baltimore, MD.



CRITERIA FOR BUYING

sufficient, also can be helpful to boards of education in tax rate management by providing all or some of the annual operating budget increase. One specific dedication in this regard is the application of the proceeds to the reduction of the capital debt of the district. Many districts, for example, have been faced with such rapid enrollment decline that buildings became surplus even before all debt on them was retired. Debt reduction is an acceptable use of sale revenues by colleges and universities, also.

Marketing surplus schools. There are varied markets for surplus educational buildings. The seller is well advised to conduct a survey of these markets before deciding to sell a building.

Public agencies of many types have purchased surplus educational buildings. They have been converted to health and welfare centers, senior citizens centers, housing, municipal offices, day care centers, community centers and, in many cases, combinations of these functions.

Other educational organizations are often interested. Colleges and universities sometimes seek a public school facility in which to locate a satellite campus. Private and parochial schools are potential clients, too.

The private sector, i.e., business, light industry or individuals, can also make use of a surplus school. Common reuses of educational buildings by the pri-private sector include hotels or motels, office buildings, apartments or condominiums, restaurants, shopping centers and mini-malls.

The seller must consider the criteria a potential buyer will apply when deciding which building to purchase. The buyer will most likely pose a series of questions, including:

1. Will the building accommodate all space needs and programs?
2. Does the building have access for handicapped persons?
3. Are the building operating costs within an acceptable range?
4. Has energy retrofitting been done on the building?
5. Will zoning laws permit the buyer's program/activity in the building?
6. Will residents near the school agree with the new use of the building?
7. Is the site location beneficial to the buyer?
8. Is the general condition of the building satisfactory and not in need of immediate renovation?
9. Does the site have sufficient parking spaces?

10. Does the building lend itself to interior renovation?

If a choice is possible, selecting the building that satisfies these criteria should result in a quicker sale at an acceptable cost.

Objections. The discussion thus far has concentrated on an essentially straightforward process. However, the process is sometimes interrupted by objections from a variety of constituencies.

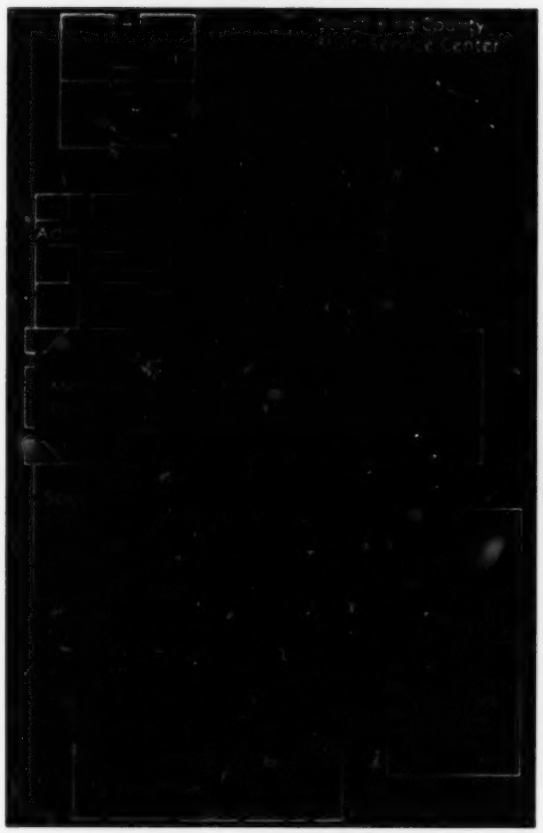
The residents of a neighborhood may object to reuse of a school for non-school purposes. Its presence may have given them a sense of tranquility and security. They may conclude that a change in the use of a school signals an unwelcome change in their neighborhood. When neighbors do not object to the sale and reuse of a school building in general, they may have specific objections to such factors as different and higher noise levels, additional traffic load, nightime use, type of population served, assumption/fear of lower property values and loss of a recreational facility.

Merchants, too, have objected to schools being put to different uses, especially if customers are lost or the new tenants provide competition for them.

College, university and public school students in several instances have raised objections to the sale of a building. Their reasons are varied and may include an emotional attachment to the school, and a belief that students displaced by the sale are being unfairly treated or that their neighborhood or campus will be adversely affected.

Parents, of course, have become the most vocal opponents to the sale of a school. Their opposition may have occurred earlier when the decision was made to close the school. They may object because of the neighborhood factors previously described or because of concerns about their children attending a new school.

Finally, the political power structure, or factions of the structure, may object to the sale of a school in a community. Its members can be quite vocal about raising the kinds of objections already discussed. They may argue that the school will be needed in the future or they may question the financial package the governing board has approved. Support for such a political constituency may result in a power block against the divestiture of a school building.



Multi-service center.

Leasing

Rationale. In the previous section, three major reasons for selling school buildings were cited. Two of these, declining enrollment and the age or condition of a building, also pertain to leasing.

It should be apparent that the difference between selling a building or leasing it rests on future needs as perceived by the owner. If the building no longer serves the owner's purposes, he sells. If the building is not now of use to the owner, but may be in the future, it might be wise to lease it rather then sell.

While some school districts and colleges/universities might argue against the closing of buildings in the face of declining enrollments, others are convinced that they have surplus space. Most debate centers around the use of individual surplus buildings. The very real problem, however, is the duration of the surplus. Will it be surplus ten, fifteen or twenty years from now? The overall school population trend, which has been on the downswing since the 1970s, appears to be on the upswing and will continue, according to estimates, through the 1990s. In the U.S., total population is expected to grow by more than one million a year for the next 67 years (U.S. Census Bureau). Although this trend will not mean an increase in all areas, these two factors are important for long-range planning and should be given due consideration in the decision-making process. Should a school district or college sell a building and then need more space several years later, in retrospect, leasing may have been a wiser course of action. On the other hand, the condition of the building and changing educational needs may show that selling was the correct choice and that a new facility is warranted.

School authorities in both Canada and the United States advise that the decision to lease (or to sell) should come from a master plan that has questioned how surplus space might be: (1) affected by Federal, state and provincial legislation, (2) used efficiently for other educationally oriented activities, (3) adapted effectively to suit future educational demands and clientele, and (4) leased or sold to other educational and/or noneducational agencies.

Retaining ownership and protecting buildings. Once it is apparent that a district or college has to give up an educational facility or space as surplus, it must consider leasing as one of its options. If retention of ownership is desired, there are only two real alternatives: leasing or "mothballing." Boarding up a surplus building ("mothballing") can have a negative effect on surrounding neighborhoods or sections of a campus, for example, by inviting vandalism. Neighborhoods and campuses tend to retain their character when buildings are kept in operation, for education or other purposes.

Potential users. While some potential purchasers might be more willing to lease, the opposite is not

necessarily true. For example, educational institutions or agencies other than an owner with surplus space might be in a better position to lease space needed than to make an outright purchase. This is especially true since little, if any, major renovations are needed to make the building fit the "new" activity, which essentially should be the same. If, however, renovations are required it usually is done at the cost of the lessee.

In fact, where long-range planning and attention to trends indicate a future need to return the building to its original purpose, it is much easier to take back the building with basically the same space configurations and design as it was prior to leasing. The lessee is often held responsible for returning the building to its original configuration.

Consideration might also be given to partial leasing, which involves organizing surplus space by each floor or wing of a building and then leasing the space for uses compatible with the school's program. Whether leasing with the idea of future reconversion to a total or partial educational facility is possible or desirable would depend on local conditions and long-range planning data.

Policy suggestions. A study of policy development conducted in the Arlington, Virginia, public schools indicated that policy development passed through three periods: a period of preparation for an uncertain future, a time of issue clarification after enrollment decline was accepted and consolidation of school began, and a time of implementation of policies that had been consolidated into a single set of priorities and procedures that recognized school and community interests.

The Grand Rapids, Michigan, public school district recognizes its responsibility to provide maximum use of its real properties. It maintains a real property inventory containing current use records of all district property and it identifies property that is underused or no longer needed for district programs. This information is reviewed periodically. The superintendent recommends sale, lease or disposition procedures for underused or un-needed real property. One of the regulations adhered to is the use of a public informational meeting to explain the proposed disposition of a specific piece of property and to receive comments.

It should be evident that specific policies related to leasing of buildings no longer needed for educational use must be formulated around the total needs of the community. This can only be accomplished after careful analysis of data and consideration of the appropriate input.

APARTMENTS AND SHOPS
REMODELED 1915 DEWITT HIGH SCHOOL — ITHACA, NEW YORK

School recycled for apartments and shops.

The Educational Program as Lessee

Rationale. Governing boards and colleges/universities may consider acquiring space by leasing, once they have determined that additional facilities are needed. (There is no such need, of course, in areas still experiencing enrollment decline.)

One reason for leasing instead of building is that it might be less expensive on an annual basis. A developer may be willing to provide a building that meets code if conditions are right for him. Such conditions include: interest rates, the need for long-term tax relief, the cooperation of a board of education or board of governors, the existence of a suitable and approvable site, and other more specific factors such as the content and length of a lease to which a board will agree and which state law will permit. Although it is not common practice for states to permit long-term leases, special-purpose legislation has been used to address this issue.

Another reason for leasing a facility instead of building is that the need for space may be short-range, e.g., less than ten years. Such a condition will affect the willingness of private developers to invest in the construction of educational buildings. However, in some states or provinces surplus schools in one district may be available on lease to others in need of space. Or specialized facilities, such as auditoriums, swimming pools and other recreational facilities, may be leased from private, non-school firms. School boards that are fiscally dependent on the voters also may have to lease because of the refusal of voters to approve funds for capital construction. A similar condition may exist for institutions of higher education that are dependent on state legislatures.

Two other reasons for the leasing of facilities were previously alluded to, namely, a lack of capital funds and the choice of the best budget strategy. Governing boards may indeed face a lack of capital funds. This is, of course, most often caused by a lack of voter or legislative support. Or voters may have given significant support but the board may have reached a legislated limit on debt (such limits exist in a number of states). In this case, the board cannot legally submit to the voters a request for more capital funds. Assuming that additional facilities are still required, leasing may be the best alternative available.

The question of a best budget strategy is a related issue. In a real sense, a lack of capital funds makes budgeting for a lease the only strategy. However, the amount of aid received from outside the school district, usually from the state level, may be bal-

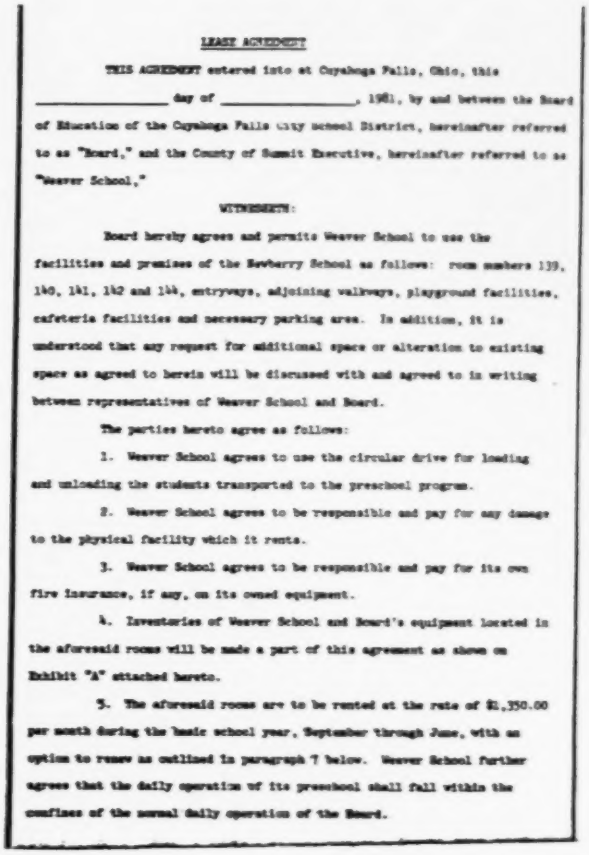
anced in favor of current operating expenses of which funds for leasing are a part. If this is the case, leasing is a viable alternative to the traditional capital funding of school facilities. On the other hand, some regulations forbid the application of state aid to the leasing of facilities. The state aid loss usually results in a higher amount of local funds being raised through taxation. It is easy to see that a knowledge of state laws and regulations is essential when a budget strategy is being decided or when capital funds are lacking. Colleges and universities also may face a lack of capital funds and may have to rely on alternative funding sources.

Constraints. Constraints to leasing may exist, depending upon the state or province. For example, leasing in some locations is not permitted by law. The prohibition is often generated by concerns that leased properties will not adhere to construction codes and will thus be unsafe. In other instances, leasing may be permitted on a case-by-case basis. Usually, separate enabling legislation is required for each case. It is generally accurate to say that the satisfaction of code is the most important constraint that has to be overcome if leasing is to be permitted.

The lessors. Several agencies can lease facilities to educational institutions if the constraints are overcome. Units of government—local, state or federal—can lease surplus, or even new, space to governing boards. Private developers will build and lease facilities, especially if the lease is for a term that is advantageous to the developer. The design-build firm, as a special type of private developer, will provide leased space. These private lessors, being essentially business-oriented and profit-motivated, may enter into a lease-purchase agreement (discussed later) if a governing board desires one.

Another lessor, although limited to the states where it is legally constituted, is the bonding authority. Based on the needs of a district or campus, the authority sells general revenue bonds and constructs a building or buildings. It then leases them, usually on a lease-purchase agreement, to a district or college/university. Then from regular and/or capital budgets, including state aid where applicable, the authority is paid an amount annually until the revenue bonds are retired. The district or college/university is given title to the school building upon the retirement of the bonds.

Lease-purchase agreement. A specific lease action resulting in the acquisition of facilities is the lease-purchase agreement. Usually, such an agreement cites an agreed-upon total cost of a building, the payment schedule and the point at which the build-



LEASE AGREEMENT

THIS AGREEMENT entered into at Cuyahoga Falls, Ohio, this _____ day of _____, 1981, by and between the Board of Education of the Cuyahoga Falls City School District, hereinafter referred to as "Board," and the County of Summit Executive, hereinafter referred to as "Weaver School,"

WITNESSETH:

Board hereby agrees and permits Weaver School to use the facilities and premises of the Newberry School as follows: room numbers 139, 140, 141, 142 and 144, entryways, adjoining walkways, playground facilities, cafeteria facilities and necessary parking area. In addition, it is understood that any request for additional space or alteration to existing space as agreed to herein will be discussed with and agreed to in writing between representatives of Weaver School and Board.

The parties hereto agree as follows:

1. Weaver School agrees to use the circular drive for loading and unloading the students transported to the preschool program.

2. Weaver School agrees to be responsible and pay for any damage to the physical facility which it rents.

3. Weaver School agrees to be responsible and pay for its own fire insurance, if any, on its owned equipment.

4. Inventories of Weaver School and Board's equipment located in the aforesaid rooms will be made a part of this agreement as shown on Exhibit "A" attached hereto.

5. The aforesaid rooms are to be rented at the rate of $1,350.00 per month during the basic school year, September through June, with an option to renew as outlined in paragraph 7 below. Weaver School further agrees that the daily operation of its preschool shall fall within the confines of the normal daily operation of the Board.

ing becomes the property of a governing board. Funding an agreement of this type involves the same financial considerations previously discussed.

In terms of cost, there is probably no particular advantage to the lease-purchase agreement. Some buildings, if constructed by a developer who is involved in large amounts of construction, may be slightly lower in cost. Others may equal the market value.

Though the payment schedule is negotiable, it is influenced by the lessor, who is providing the funds for construction. The length of the agreement is not unlike regular payback schedules. It varies according to similar criteria such as the speed with which the investor wants to be repaid, the annual payback amounts that boards can appropriate and the necessity for boards to consider tax rate management and/or annual state appropriations.

Regulations governing lease-purchase agreements also vary. Some states have a prescribed form and require approval of an agreement by the commissioner of education or higher education, or by the attorney of the state or province. Others have special plan and code reviews to assure that the building being acquired meets the construction code of the state.

During the life of the lease, it is common practice for the building to be treated like it is owned by a governing board. The board assumes complete responsibility for operations including maintenance and insurance.

JOINT LEASE AGREEMENT

APPLICATION FOR PERMIT

Day of Week .....

To The Board of Public Education:

Application is hereby made by the ..... (Name of Organization)

for use of ..... (Part of building ground) at the ..... (Name of School) School

between the hours of ..... and ..... on the following dates:

January	.....	.....	.....	.....	July	.....	.....	.....	.....	.....
February	.....	.....	.....	.....	August	.....	.....	.....	.....	.....
March	.....	.....	.....	.....	September	.....	.....	.....	.....	.....
April	.....	.....	.....	.....	October	.....	.....	.....	.....	.....
May	.....	.....	.....	.....	November	.....	.....	.....	.....	.....
June	.....	.....	.....	.....	December	.....	.....	.....	.....	.....

Purpose of the use of school property .....

Approximate attendance expected at each use .....

Leader or Instructor .....

Special Requests ..... (Add or list of equipment, map uses, etc.)

Under the Board's regulations governing permits, the following amount/s are being charged for use of the above facilities:

Rental Charge $ ..... Custodial Charge $ ..... Other Personnel Charges $ .....

The total amount, $ ..... is to be deposited with the board when the permit is granted.

THE ABOVE CHARGES ARE SUBJECT TO FINAL ADJUSTMENT. THERE MAY BE ADDITIONAL CHARGES OR REFUNDS WHEN REQUIRED PURSUANT TO BOARD REGULATIONS GOVERNING PERMITS.

Date .....

I have read, understand and agree to abide by the rules and regulations on the reverse side of this application.

(Signed) ..... (Title)

(Organization) .....

Address .....

Phone .....

Recommended .....

Approved .....

See other side of this sheet for Rules and Regulations of the Pittsburgh Board of Public Education governing permits.

ALL COPIES of Application are to be forwarded to the Business Office. After approval of application, the appropriate copies will

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